THE STATUS OF SYNTHETIC FUELS AND COST-SHARED ENERGY R&D FACILITIES

HEARINGS

BEFORE THE

SUBCOMMITTEE ON
ENERGY DEVELOPMENT AND APPLICATIONS

OF THE

COMMITTEE ON
SCIENCE AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

NINETY-EIGHTH CONGRESS

SECOND SESSION

JUNE 6, 7, 13, 1984

[No. 106]

Printed for the use of the
Committee on Science and Technology

36-903 O

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1984

H701-76

COMMITTEE ON SCIENCE AND TECHNOLOGY

DON FUQUA, Florida, *Chairman*

ROBERT A. ROE, New Jersey
GEORGE E. BROWN, Jr., California
JAMES H. SCHEUER, New York
RICHARD L. OTTINGER, New York
TOM HARKIN, Iowa
MARILYN LLOYD, Tennessee
DOUG WALGREN, Pennsylvania
DAN GLICKMAN, Kansas
ALBERT GORE, Jr., Tennessee
ROBERT A. YOUNG, Missouri
HAROLD L. VOLKMER, Missouri
BILL NELSON, Florida
STAN LUNDINE, New York
RALPH M. HALL, Texas
DAVE McCURDY, Oklahoma
MERVYN M. DYMALLY, California
PAUL SIMON, Illinois
NORMAN Y. MINETA, California
RICHARD J. DURBIN, Illinois
MICHAEL A. ANDREWS, Texas
BUDDY MacKAY, Florida
TIM VALENTINE, North Carolina
HARRY M. REID, Nevada
ROBERT G. TORRICELLI, New Jersey
FREDERICK C. BOUCHER, Virginia

LARRY WINN, Jr., Kansas
MANUEL LUJAN, Jr., New Mexico
ROBERT S. WALKER, Pennsylvania
WILLIAM CARNEY, New York
F. JAMES SENSENBRENNER, Jr., Wisconsin
JUDD GREGG, New Hampshire
RAYMOND J. McGRATH, New York
JOE SKEEN, New Mexico
CLAUDINE SCHNEIDER, Rhode Island
BILL LOWERY, California
ROD CHANDLER, Washington
HERBERT H. BATEMAN, Virginia
SHERWOOD L. BOEHLERT, New York
ALFRED A. (AL) McCANDLESS, California
TOM LEWIS, Florida

HAROLD P. HANSON, *Executive Director*
ROBERT C. KETCHAM, *General Counsel*
REGINA A. DAVIS, *Chief Clerk*
DAVID S. JEFFERY, *Minority Staff Director*

SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS

DON FUQUA, Florida, *Chairman*

RICHARD L. OTTINGER, New York
TOM HARKIN, Iowa
RALPH M. HALL, Texas
PAUL SIMON, Illinois
RICHARD J. DURBIN, Illinois
FREDERICK C. BOUCHER, Virginia
ROBERT A. ROE, New Jersey
JAMES H. SCHEUER, New York
MARILYN LLOYD, Tennessee
ROBERT A. YOUNG, Missouri
BILL NELSON, Florida
DAVE McCURDY, Oklahoma
NORMAN Y. MINETA, California

F. JAMES SENSENBRENNER, Jr., Wisconsin
CLAUDINE SCHNEIDER, Rhode Island
BILL LOWERY, California
HERBERT H. BATEMAN, Virginia
TOM LEWIS, Florida
WILLIAM CARNEY, New York
JUDD GREGG, New Hampshire

CONTENTS

WITNESSES

Page

June 6, 1984:

- Hon. Marilyn Lloyd, a Representative in Congress from the State of Tennessee 2
- Hon. Doug Walgren, a Representative in Congress from the State of Pennsylvania 19
- Hon. Howard Wolpe, a Representative in Congress from the State of Michigan 25
- Hon. Richard J. Durbin, a Representative in Congress from the State of Illinois 32
- Hon. Danny J. Boggs, Deputy Secretary, U.S. Department of Energy 39
- Edward E. Noble, Chairman, U.S. Synthetic Fuels Corporation, accompanied by Leonard C. Axelrod, Group Vice President for Operations; Hodson Thornber, Vice President, Finance; and Jeffrey Lipkin, General Counsel 74

June 7, 984:

- William A. Vaughan, Assistant Secretary for Fossil Energy, U.S. Department of Energy, accompanied by Donald L. Bauer, Principal Deputy Assistant Secretary for Fossil Energy, U.S. Deprtment of Energy 107
- Dwain F. Spencer, vice president, advanced power systems, Electric Power Research Institute 161
- David O. Webb, senior vice president, policy and regulatory affairs, Gas Research Institute 185

June 13, 1984:

- Hon. Pat Collins, Under Secretary and Acting Assistant Secretary for Conservation and Renewables, Department of Energy, Washington, DC, accompanied by Donna Fitzpatrick, Principal Deputy Assistant Secretary for Conservation and Renewables, Department of Energy; Robert San Martin, Deputy Assistant Secretary for Renewable Energy, Department of Energy; and Alan J. Streb, Deputy Assistant Secretary for Conservation, Department of Energy 210
- Dr. Maxine Savitz, Washington, DC; and Dr. Ian Straughan, director of research, Southern California Edison, Rosemead, CA 256

Appendix I—Additional questions and answers submitted for the record 291
Appendix II—Additional statements for the record 327

THE STATUS OF SYNTHETIC FUELS AND COST-SHARED ENERGY R&D FACILITIES

WEDNESDAY, JUNE 6, 1984.

House of Representatives,
Committee on Science and Technology,
Subcommittee on Energy Development and Applications,
Washington, DC.

The subcommittee met, pursuant to call, at 9:30 a.m., in room 2318, Rayburn House Office Building, Hon. Don Fuqua (chairman of the subcommittee) presiding.

Mr. **Fuqua**. The subcommittee will be in order.

The hearing today is on the status of the country's synthetic fuels program. As originally planned, it would have been an update on the Synthetic Fuels Corporation's actions in providing financial assistance to synthetic fuels projects, and a review of the Corporation's plans for preparing a comprehensive strategy.

At that time it also seemed that supporters of synthetic fuels, such as I, would be able to point to considerable progress in the SFC's awarding contracts to facilities providing pioneering synthetic fuels capacity. Despite management problems and much delay, which has concerned supporters and detractors alike, the program finally appeared to be moving forward.

These plans now seem like so many pipedreams. The SFC does not have a quorum and it cannot operate. Projects that were near approval now face renewed uncertainty.

The administration has taken a position that a substantial reduction in synthetic fuels funding and a close linkage of that funding to the market is necessary, and has transmitted legislation designed to accomplish those ends to Congress. Although it has not officially done so, the impression is that the administration also ties the submission of nominations to the SFC Board to prior congressional approval of the proposed legislation.

Circumstances surrounding energy supplies and costs have changed since the Energy Security Act was signed and funds were provided for the synthetic fuels program. Some of the concerns of that time are less strongly felt since crises have receded.

On that basis, some reevaluation of synthetic fuels goals may be necessary, but I hope this hearing will aid that process.

However, I want to say straight out and very strongly that I disagree with a reduction of synthetic fuels funding of the magnitude contained in the administration's proposed legislation.

The message to Congress accompanying the legislation says, "This legislation reaffirms the Nation's commitment to a long-range program of developing a private sector synthetic fuels industry."

I am hard pressed to discover how reducing existing funding by two-thirds, imposing new restrictions on projects, and deleting several projects which were at the threshold of being funded reaffirms long-range commitments.

I am also opposed to applying a vague and imprecise market pricing criteria to SFC-supported projects. The main consideration in forming a Government-financed corporation was the realization that the market would not provide the necessary incentives for the orderly, early establishment of synthetic fuels capacity. This capability was judged necessary for security reasons, not for market reasons.

Although perceptions of security requirements have changed somewhat because of different world conditions, current Middle East warfare continues to underline the long-term need for secure energy sources, including those such as synthetic fuels, which are not economic in 1984.

And finally, I also believe that it is incumbent upon the administration to make a good-faith effort to nominate members to the Board of the SFC within a reasonable time. Unlike most Government agencies, the SFC cannot operate without a quorum of Board members. The message to Congress reaffirming a commitment to synthetic fuels does not do so without a complementary action submitting nominations for the Board.

And I hope that these issues will be addressed during the hearings today.

And our first witness will be a member of our committee and one who has been very interested in this program, the distinguished lady from Tennessee, Mrs. Lloyd. Marilyn, we are very happy to have you.

STATEMENT OF HON. MARILYN LLOYD, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TENNESSEE

Mrs. Lloyd. Thank you very much, Mr. Chairman.

It feels strange on this side of the table, I have never been here before. I think it is probably good experience——

Mr. Fuqua. You may come up here if you wish.

Mrs. Lloyd [continuing]. For all of us on this side.

I do appreciate this opportunity to testify today on the Subcommittee on Energy Development and Applications on the status of the Synthetic Fuels Corporation.

Mr. Chairman, I do have two purposes in testifying today. First, I intend to discuss the need for an enhanced coal research and development program and also to outline the rationale for the near-term electric utility element of my proposed legislation, H.R. 5592 and H.R. 5593.

Although there is not sufficient evidence to provide a firm basis for specific controls on powerplant emissions, we must provide the utilities with the contingency of alternative technologies to minimize the economic impact of controls which might be imposed, irrespective of the lack of scientific basis.

My second purpose in testifying is to discuss the longer term element of the bill in the framework of the need for a dialog in the House and Senate on the nature of a synthetic fuels program which is now appropriate.

I believe recent events dictate that the Congress should now seek to formulate a modified synfuels strategy. In the light of the rescission which has now been proposed by the administration, we must develop an appropriate response to protect our emerging synfuels capability.

Earlier last month, I introduced H.R. 5593, the Clean Coal Production and Utilization Technology Demonstration Act, which is designed to address the problems currently facing the coal industry and utilities regarding the environmentally acceptable use of coal.

The first goal of this bill is to expedite existing efforts so as to broaden technology options for mitigating acid rain effects by demonstrating the feasibility of alternatives to wet scrubbers.

This legislation is also aimed at encouraging a focused demonstration effort to accelerate longer term technologies for coal utilization into the marketplace.

The legislation specifies four near-term technologies to consider for demonstration which, although promising, have not been proven at utility scale. It provides for at least seven longer term, second generation technology demonstration projects which may allow us to achieve cost-effective, clean coal usage by the end of the century.

The Secretary is also authorized to demonstrate other technologies to reduce powerplant and combustion emissions and to test technologies for exploiting the gas and oil resources present in eastern shale. Overall, the emphasis of the bill is very similar to the engineering and development section of Mr. Walgren's excellent bill, H.R. 5044, which has been a catalyst for coal legislation in the House.

Mr. Chairman, I believe it is important to provide clear guidance to the Department of Energy as to which types of technologies should be considered as demonstration candidates. The DOE has indicated that they would prefer this approach to a generic authorization bill for such technology demonstrations as long as a broad spectrum of technologies is encompassed.

My specific concern about a generic approach is the danger that the Appropriations Committee will then decide the programs direction.

The bill, H.R. 5593, which presently has 27 cosponsors, differs from all other coal technology bills chiefly in the funding mechanism. Since the major overall goal of this legislation is to foster technology to enhance coal utilization and, thus, reduce our dependence on foreign oil, I maintain that it makes sense to set aside part of the Synthetic Fuels Corporation funding for these purposes.

It is clear that there will be additional attempts to raid the energy security reserve unless we achieve a consensus in the Congress on a DOE companion program and counteroffensive synfuels strategy which cover the spectrum of risk from semiworks to the marketplace.

It is important that we understand the considerable risk involved in demonstrating emission control technologies at powerplant size in the range of 100 to 150 megawatts. Given the economic uncertainties and technological risk in scale-up, the need for a Federal role is straightforward.

However strongly we believe, Mr. Chairman, in industry cost-sharing for these projects, clearly an important requirement, I would hope that the committee will carefully consider the question of mandating specific levels of minimum cost sharing.

I have specifically avoided stipulating such percentages in my bill, chiefly because the relative risk and appropriate cost sharing vary from technology to technology.

My bill presumes that the present research and technology base program in Fossil R&D, augmented by roughly $200 million per year for 10 years for technology demonstration projects at pilot plant scale, constitutes a meaningful program.

This program can be solidly defended in the framework of Federal energy priorities. The resource requirements of this program bring me back to the recommended funding mechanism in H.R. 5593 and the second major topic I wish to discuss, that is, the type of program we need for a U.S. synthetic fuels capability.

It is disturbing to me that as we deliberate on energy policy questions and while a new cast of administration spokesmen call for SFC funding of only the most "economically viable" projects, ships are being sunk almost daily in the Persian Gulf. Thus, the long-feared stoppage of traffic through the Straits of Hormuz, with prospects for the most severe worldwide disruption since 1973, appear close at hand.

With the administration's proposal of a rescission of $9.5 billion from the energy security reserve, I believe it is clearly time for the Congress to propose a vigorous counterstrategy for developing the U.S. synthetic fuels capability.

Section 3(a) of my bill identifies coal conversion and combustion technologies which should be considered in terms of demonstration facilities. The source of funding for such activities should be considered in the context of a revised but constructively supportive synthetic fuels strategy.

I am not wed to any specific projects, but I have applied two major criteria in arriving at a revised SFC strategy. First, we need other sources of liquid fuel from domestic resources and clearly shale oil and coal liquefaction are the primary avenues for fulfilling this need.

Second, I recognize that it makes sense to encourage awards to projects such as Great Plains and Union, which the SFC has already indicated they would support and to pursue negotiations where there are signed letters of intent or negotiations in final stages.

I have attempted to incorporate the most appealing of the proposals still before the Corporation into a revised portfolio.

I should point out that the industry consensus is that unless a plant is built to demonstrate a direct liquefaction process at least at commercial module size, the corporate memory for this critical technology will be lost.

The proposed generic portfolio for the phase I program plus Great Plains and the direct liquefaction scale-up constitute a slightly more modest approach than the SFC basic business plan, in other words, roughly $3 billion less in obligational requirements which should be retained as an ESA contingency fund. I believe that the DOE semiworks program in my bill forms a strong complement to this phase I effort.

Mr. Chairman, I have included the details of my suggested strategy in my written statement for the record. I should mention that this approach could still allow for the return of $2 to $3 billion to the Treasury from the energy security reserve if the contingency fund is not used.

I hope that my proposal elicits constructive discussion from both the administration and the Congress so that we can move toward a strong synthetic fuels capability without the necessity of a massive synthetic fuels program.

I also hope that as acid rain research progresses on causes and effects, that the Federal Government can aid the industry in reducing the risk of adopting alternative technologies. In this manner, the utilities can have a broader set of options to choose from if and when controls are enacted—hopefully on a hard cost/benefit basis.

Mr. Chairman, I would like to submit additional material for the record on the funding requirements and the project breakdown for the SFC Pioneer Plant portfolio. I am going to submit additional.

Much of this is taken from an excellent report prepared by International Energy Associates, Ltd., with some changes which are noted.

Mr. Chairman, it is time for the supporters of the synfuels program to be resolute. This being the 40th anniversary of "The Longest Day," it is appropriate to take encouragement from one of the grand architects of the D-day invasion, Winston Spencer Churchill. He said over 40 years ago:

> Never give in * * * never, never * * * in nothing great or small, large or petty—never give in except to convictions of honor and good sense.

Thank you, Mr. Chairman.

[The prepared statement of Mrs. Lloyd follows:]

HON. MARILYN LLOYD
STATEMENT
BEFORE THE
SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS
HEARING ON THE STATUS OF THE SYNTHETIC FUELS CORPORATION
June 6, 1984

Mr. Chairman, I appreciate this opportunity to testify before the Subcommittee on Energy Development and Applications on the status of the Synthetic Fuels Corporation. I am one of those, perhaps of a dwindling number of Members, of this body who continues to believe in the urgency, both economic and military, that is associated with secure, available, and sufficient supplies of domestic energy resources. I am convinced that our existing and near-at-hand technologies can make this goal attainable if we in policy positions will avoid the abrupt shifts that have plagued energy development in this country over the past decade. We are all aware of the stand-off that now exists with regard to synthetic fuels today. The Administration, and, in particular the Office of Management and Budget, have held hostage Board nominees to the SFC in an effort to force approval of their rescission request. I have proposed legislation which authorizes a companion program complementary to that of the Synfuels Corporation. I believe that this legislation offers a constructive and balanced approach to address the need for secure deomestic energy supplies at reasonable cost, and compatible with our environmental responsibilities and our need to control spending.

Mr. Chairman, I have two purposes in testifying today. First, I intend to discuss the need for an enhanced coal research and development program and outline the rationale for the near-term electric utility element of my proposed legislation, H.R. 5592 and H.R. 5593. Although there is not sufficient evidence to provide a firm basis for specific controls on powerplant emissions, we must provide the utilities with the contingency of alternative technologies to minimize the economic impact of controls which might be imposed, irrespective of the lack of scientific basis. My second purpose in testifying is to discuss the longer-term element of the bills in the framework of the need for a dialogue in the House and Senate on the nature of a synthetic fuels program which is now appropriate. I believe recent events dictate that the Congress should now seek to formulate a modified synfuels strategy. In the light of the rescission which has been proposed by the Administration, we must develop an appropriate response to protect our emerging synfuels capability.

Earlier this month, I introduced H.R. 5593, the "Clean Coal Production and Utilization Technology Demonstration Act," which is designed to address the problems currently facing the coal industry and utilities regarding the environmentally acceptable use of coal. The first goal of this bill is to expedite existing efforts so as to broaden technology options for mitigating acid rain effects by demonstrating the feasibility of alternatives to wet scrubbers. This legislation is also aimed at encouraging a focused demonstration effort to accelerate longer-term technologies for coal utilization into the marketplace. Given the private sector's reluctance to assume the risk of proving out new technologies for enhancing the environmental acceptability of coal utilization, it has become increasingly evident that Government action is not only warranted but necessary.

This legislation establishes a technology demonstration program targeted at the most promising advanced systems for coal burning and cleaning, as well as coal conversion to liquids and gases. Thus, its intermediate goal is to reduce air pollution from coal-burning powerplants and other facilities. The longer-term goal is to demonstrate more efficient and environmentally acceptable processes for both advanced coal combustion and the production of coal-derived fuels. The program would be administered by the Secretary of Energy in addition to his other responsibilities for coal research and development.

The legislation specifies four near-term technologies to consider for demonstration which, although promising, have not been proven at utility scale. It provides for at least seven longer-term, second generation technology demonstration projects which may allow us to achieve cost-effective, clean coal usage by the end of the century. The Secretary is also authorized to demonstrate other technologies to reduce powerplant and combustion emissions and to test technologies for exploiting the gas and oil resources present in Eastern shale. Overall, the emphasis of the bill is very similar to the engineering development section of Mr. Walgren's excellent bill, H.R. 5044, which has been a catalyst for coal legislation in the House.

Mr. Chairman, I believe it is important to provide clear guidance to the Department of Energy as to which types of technologies should be considered as demonstration candidates. The DOE has indicated that they would prefer this approach to a generic authorization bill for such technology demonstrations as long as a broad spectrum of technologies is encompassed. My specific concern about a generic approach is the danger that the Appropriations Committee will then decide the program direction. Industry has also indicated that it is important to spell out goals for the emission control technologies so long as the statutory language does not restrict the demonstration candidates to a specific design or unique process. The criteria which the Secretary would be required to develop pursuant to Sec. 4 of H.R. 5593 should also prove useful to the DOE in choosing such candidate demonstration projects. I wish to emphasize that projects for the candidate technologies are not mandated in either bill and, moreover, unspecified technologies which reduce emissions can be demonstrated under Sec. 3(b)(5).

The bill, H.R. 5593, which presently has 27 cosponsors, differs from all other coal technology bills chiefly in the funding mechanism. Since the major, overall goal of this legislation is to foster technology to enhance coal utilization and, thus, reduce our dependence on foreign oil, I maintain that it makes sense to set aside part of the Synthetic Fuels Corporation funding for these purposes. I also introduced a bill, H.R. 5592, which simply authorizes appropriations for the same projects as are contained in H.R. 5593, but without reference to the SFC funds. The events of recent weeks have led me to believe that there is significantly greater interest in H.R. 5593, for example, the action already taken during Senate budget deliberations to rescind $2 billion of the Energy Security Reserve. Coal and shale are such important domestic resources that we cannot afford to divert any of these earmarked funds. It is is clear there will be additional attempts to raid the Energy Security Reserve and strong pressures could build for acquiescence to the Administration's proposed rescission unless we achieve a consensus in the Congress on a DOE companion program and counter-offensive synfuels strategy which cover the spectrum of risk from semi-works to the marketplace.

Before I describe my modest proposal, which I intend to have serve as a vehicle for dialogue on a modified SFC strategy, I should like to briefly discuss the acid rain issue. There are two major aspects of this dilemma facing the utilities in terms of any present mandating of the emission controls with respect to acid rain. First, it is clear that the acceptable technological alternatives to today's very unsatisfactory wet scrubbers have not been demonstrated at powerplant scale. Second, we simply don't have many of the facts we need about the effects of acid precipitation to identify what benefits would be derived from controlling specific pollutants such as sulfur dioxide. For example, we don't know which pollutants are most damaging to our forests and crops, or how sulfur dioxide gets converted to its acidic form, or even what SO_x and NO_x chemistry is most important.

I believe it is reasonable to expect that some controls may become effective in the next decade in spite of the absence of a data base. Thus, we must provide the utilities with the broadest range of options for achieving desirable emission reductions. I should note here that the LIMB system, although funded by EPA, has been included in my bill because I simply don't feel confident that EPA is capable of successfully carrying out an R&D technology demonstration project. Should the EPA demo go forward successfully, I presume that the Secretary would choose not to select a LIMB project. Similarly, I have felt it is important to include an Atmospheric Fluidized Bed (AFB) system for SO_2 and NOx removal because my input is that the TVA/EPRI/DOE project is not the last word in AFB technology for SO_2, NO_x or particulate removal.

It is important that we understand the considerable risk involved in demonstrating emission control technologies at powerplant size, i.e., in the range of 100 to 150 Mwe. Given the economic uncertainties and technological risk in scale-up, the need for a federal role is straightforward. However strongly we believe, Mr. Chairman, in industry cost-sharing for these projects, clearly an important requirement, I would hope that the Committee will carefully consider the question of mandating specific levels of minimum cost-sharing. I have specifically avoided stipulating such percentages in my bill, chiefly because the relative risk and appropriate cost-sharing vary from technology to technology. It is desirable to set goals for industry cost-sharing, but to stipulate absolute minimums narrows the options for both DOE and industry and allows for less flexibility in the face of changing circumstances. I would remind the Committee of the difficulties which certain project sponsors have encountered before the SFC because specific equity requirements have become a virtual "Catch 22," even after prolonged, good-faith negotiations. Also, we should note that the 60/40 cost-sharing provision of the Energy Security Act on project modules had no "takers."

Mr. Chairman, we can see that the Fossil Energy R&D program has survived a most difficult three-year period. The FY 1981 appropriations for Fossil R&D which included some significant commitments to large demonstration plants came to roughly $1.7 billion. The Reagan Administration's budget request for coal, oil, gas, and shale R&D in FY 1985 is just one-sixth of that amount. The Congress has recognized that there must be a stronger Fossil R&D program in DOE with a majority of the resources devoted to a coal development program. My bill presumes that the present research and technology base program in Fossil R&D, augmented by roughly $200 million per year for ten years for technology demonstration projects at pilot plant scale, constitutes a meaningful program.

This program can be solidly defended in the framework of federal energy priorities. The resource requirements of this program bring me back to the recommended funding mechanism in H.R. 5593 and the second major topic I wish to discuss, that is, the type of program we need for a U.S. synthetic fuels capability.

It is disturbing to me that as we deliberate on energy policy questions and while a new cast of Administration spokesmen call for SFC funding of only the most "economically viable" projects, ships are being sunk almost daily in the Persian Gulf. Thus, the long-feared stoppage of traffic through the Straits of Hormuz, with prospects for the most severe worldwide disruption since 1973, appears closer at hand. Despite strong Congressional support in both Houses and the acquiescence, although not the active support, of the Administration, the Synthetic Fuels Corporation has not been able to catalyze the initiation of a domestic synthetic fuels capability.

With the Administration's proposal of a rescission of $9.5 billion from the Energy Security Reserve, I believe it is clearly time for the Congress to propose a vigorous counter-strategy for develpping the U.S. synthetic fuels capability. Section 3(a) of my bill identifies coal conversion and combustion technologies which should be considered in terms of demonstration facilities. The source of funding for such activities should be considered in the context of a revised but constructively supportive synthetic fuels strategy. I shall not dwell on the details, but will simply briefly describe my suggested strategy which includes the DOE "Companion Program" proposed in my bill (which is somewhat broader than synfuels), as a complement to a suggested Portfolio of Pioneer Plant projects to be awarded support by the SFC.

Mr. Chairman, I believe it is important to recognize that what this country needs is a synthetic fuels capability, but the SFC will have fulfilled its responsibilities as an institutional mechanism by awarding the $9.8 billion for the Pioneer Plant Porfolio. The DOE has maintained the capability to manage large projects and logically should be transferred the responsibility to monitor these activities.

I am not wed to any specific projects, but I have applied two major criteria in arriving at a revised SFC strategy. First, we need other sources of liquid fuel from domestic resources and clearly shale oil and coal liquefaction are the primary avenues for fulfilling this need. Secondly, I recognize that it makes sense to encourage awards to projects such as Great Plains and Union, which the SFC has already indicated they would support and to pursue negotiations where there are signed letters of intent or negotiations in final stages. I have attempted to incorporate the most appealing of the proposals still before the Corporation into the revised Portfolio. I should point out that the industry consensus is that unless a plant is built to demonstrate a direct liquefaction process at least at commercial, module size, the "corporate memory" for this critical technology will be lost. The Proposed Generic Portfolio for the Phase I Program plus Great Plains and the direct liquefaction scale-up constitute a slightly more modest approach than the SFC Basic Business Plan, i.e., roughly $3 billion less in obligational requirements which should be retained as an ESA contingency fund. I believe that the DOE semi-works program in my bill forms a strong complement to this Phase I effort.

Mr. Chairman, I don't believe it is presumptuous to suggest that the SFC (if the impasse can be broken with the Administration) could make a limited number of awards and then dissolve without any necessity of pursuing a so-called "phase two" activity. In order to collect the "lessons learned" from such projects, the DOE should be assigned the monitoring function which they now perform for the Great Plains Coal Gasification Project.

A third criteria which I applied in arriving at this revised program is the need to retain a coherent body of knowledge within the Department of Energy to sustain a broad synthetic fuels capability. This is the basis for proposing that DOE conduct a ten year, $2 billion program to construct semi-works (pilot plant) facilities for coal conversion and combustion in addition to funding cost-shared projects with industry for acid rain mitigation technologies.

Mr. Chairman, I have included the details of my suggested strategy in my written statement for the record. I should mention that this approach could still allow for the return of $2 to $3 billion to the Treasury from the Energy Security Reserve if the Contingency Fund is not used. I hope that my proposal elicits constructive discussion from both the Administration and the Congress so that we can move toward a strong synthetic fuels capability without the necessity of a massive synthetic fuels program. I also hope that as acid rain research progresses on causes and effects, the Federal government can aid the utility industry in reducing the risk of adopting alternative technologies. In this manner, the utilities can have a broader set of options to choose from if and when controls are enacted (hopefully on a hard cost/benefits basis).

Mr. Chairman, I would like to submit additional material for the record on the funding requirements and the project breakdown for the SFC Pioneer Plant Portfolio. Much of this is taken from an excellent report prepared by International Energy Associates Limited with some changes which are noted.

Mr. Chairman, it is time for the supporters of the synfuels program to be resolute. This being the 40th anniversary of "The Longest Day," is appropriate to take encouragement from one of the grand architects of the D-Day invasion, Winston Spencer Churchill. He said over 40 years ago, "Never give in...never, never,...in nothing great or small, large or petty -- never give in except to convictions of honor and good sense."

Thank you.

TABLE 1

PROPOSED GENERIC PORTFOLIO FOR SFC PHASE I PROGRAM

	Billions of $
OIL SHALE DEVELOPMENT	
Union Oil (under contract)	0.4
Two additional projects, nominal size, different technologies, including both Colorado and Utah locations.	2.2
One project representing first-of-a-kind scale-up experience, building on the above set of base projects.	2.7
SECOND-GENERATION COAL GASIFICATION	
Cool Water (under contract) application in utility sector.	0.1
One project, eastern location, application in industrial sector, different technology.	1.5
EARLY EXPERIENCE AND GENERIC SUPPORT TO BOTH GASIFICATION AND DIRECT LIQUEFACTION OF COAL	
Great Plains (under contract)	0.7
Great Plains price support supplement.	0.8
DIRECT COAL LIQUEFACTION	
Modular Scale-up	1.7
SUPPLEMENTAL "LIQUIDS"	
Coal/water (several projects, both industry and utility applications).	0.3
Tar Sands and Heavy Oil (diverse technologies, two or three projects depending on cost).	0.5
SUBTOTAL	10.9

TABLE 2

ALLOCATION OF AVAILABLE SFC OBLIGATIONAL AUTHORITY

ITEM	BILLIONS OF $
1. SFC PORTFOLIO REQUIREMENTS	
Recommended Portfolio	10.9
Included in DOE Authority (Great Plains and Union)	(1.1)
Included in Portfolio but lacking industry proposal for support (Direct liquefaction Scale-up)	(1.7)
SFC Obligational Authority needed	8.1
2. ALLOCATION OF SFC OBLIGATIONAL AUTHORITY	
Available from Basic Business Plan	14.8
Needed for Portfolio	(8.1)
Transfer to DOE for Direct Liquefaction Scale-up	(1.7)
Transfer to DOE for Companion Program	(2.0)
ESA Contingency Fund	3.0*

*included as offset against other government needs in IEA Ltd. report.

Mr. FUQUA. And without objection, retroactively, permission will be granted to take photographs and recordings during the course of the proceedings today.

And also without objection, statements by Mr. Winn and Mr. Broyhill will be made part of the record.

[The prepared statements of Mr. Winn and Mr. Broyhill follow:]

STATEMENT OF
THE HONORABLE LARRY WINN, JR.
HEARING ON THE STATUS OF SYNTHETIC FUELS
JUNE 6, 1984

THANK YOU, MR. CHAIRMAN, FOR THIS OPPORTUNITY TO WELCOME OUR WITNESSES. ALTHOUGH OUR TESTIMONY TODAY WILL CONCERN ITSELF WITH THE STATUS OF SYNTHETIC FUELS, WE APPRECIATE THE FACT THAT THIS IS A THREE-DAY SERIES WHICH WILL CONSIDER COST-SHARED ENERGY TECHNOLOGY FACILITIES RELATED BOTH TO FOSSIL ENERGY, AND TO RENEWABLE ENERGY AND CONSERVATION.

WE HAVE REALIZED FOR QUITE SOME TIME THAT THE NECESSARY TECHNOLOGICAL STEPS FROM AN IDEA TO COMMERCIAL REALITY REQUIRE SEVERAL FINITE STEPS. BASIC RESEARCH, FOLLOWED BY ITS APPLICATION, LEADS TO PROOF-OF-CONCEPT EXPERIMENTS. WITH THOSE BASIC DATA IN HAND WE ARE THEN ABLE TO LOOK AT A PROCESS IN A DEVELOPMENT UNIT, SUCH AS A GASIFIER OR A COMBUSTER. THAT INFORMATION THEN LEADS TO THE CONSTRUCTION OF A PILOT PLANT, OR A SEMI-WORKS FACILITY, TO OBTAIN THE KIND OF DATA WHICH WILL ALLOW US, SUBSEQUENTLY, TO BUILD A DEMONSTRATION FACILITY. A DEMONSTRATION PLANT GIVES US A

VERY GOOD IDEA OF THE PROCESS, BOTH TECHNICALLY AND ECONOMICALLY, SO THAT WE CAN JUSTIFY THE DESIGN, CONSTRUCTION AND OPERATION OF A COMMERCIAL FACILITY.

IN THE PAST SEVERAL YEARS COMMITTEE-SPONSORED INVESTIGATIONS OF VARIOUS ENERGY PROCESSES HAVE GONE FORWARD AT VARYING SPEEDS. IN SOME CASES WE HAVE COLLECTED SUFFICIENT INFORMATION TO ENABLE US TO EVALUATE COMMERCIAL OPERATION. IN OTHER CASES WE HAVE STOPPED SHORT OF PILOT AND DEMONSTRATION PLANT OPERATIONS. THEREFORE, WE ARE NOT ABLE TO MAKE VALID JUDGEMENTS AS TO CONTINUATION OF THOSE PROCESSES. OUR INTEREST TODAY AND IN THESE NEXT TWO SESSIONS WILL BE TO DETERMINE IF THOSE TECHNOLOGIES DO EXIST WHICH LACK THESE BASIC COMMERCIALIZATION DATA, AND IF SO, WHAT THEY ARE. IF SUCH A NEED EXISTS WE THEN WOULD REQUEST SUGGESTIONS AND RECOMMENDATIONS ON THE FEDERAL ROLE, IF ANY, TO CORRECT OR IMPROVE ON CURRENT CONDITIONS.

MR. CHAIRMAN, TODAY WE LOOK FOR TECHNICAL GUIDANCE RATHER THAN RHETORIC. HOPEFULLY WE WILL RECEIVE INFORMATION BENEFICIAL TO US ALL.

THANK YOU.

TESTIMONY OF THE HONORABLE JAMES T. BROYHILL
RANKING MINORITY MEMBER
HOUSE COMMITTEE ON ENERGY AND COMMERCE

BEFORE THE SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS
COMMITTEE ON SCIENCE AND TECHNOLOGY

JUNE 6, 1984

My views on the Synthetic Fuels Corporation are no secret. I have no confidence in either the concept or the competency of the SFC. Incompetence can be remedied by bringing in new management, but a flawed concept will defeat the best efforts of good people. The only answer is to get rid of the whole concept. That is what I propose should be done with the SFC and I have introduced legislation to do it, H.R. 5761.

The SFC puts the Federal Government in the role of picking "winners" and "losers" in a race against the marketplace. Given this impossible assignment, we should not be surprised at the SFC's lack of success. Productive economic development is driven by competition, innovation and risk taking, not by government price guarantees. Efforts by Congress to "help" the market or "supplement it" always fail because the market is not something that Congress can control.

Contrary to the original hopes of the SFC's creators, the continued operation of the SFC will cost taxpayers billions of dollars. No one now disputes that. Based on the SFC's oil price projections which assume real growth in crude oil prices of 2.5 percent per year, the SFC would spend about $2.5 billion by the end of this decade. This is not a small amount, but if the Energy Information Administration's current oil price estimates are used, the number is much larger. The EIA projects declining real oil prices over the next few years with no increase in real oil prices until the end of the decade.

Regardless of whose oil price projections are chosen, the point is, taxpayers are at risk for billions of dollars. With a $170 billion dollar deficit, even $1 billion is far too much to waste.

What will the taxpayers receive for their dollars? We are told that valuable information could be gained from a few pioneer synfuel plants. But why won't private industry develop that information? Chevron is testing a semi-works shale oil retort at a refinery in Salt Lake City. Tennessee-Eastman has built a syngas plant in Tennessee. The plant is now being operated to produce methanol for use in gasoline blending. Representatives of Tennessee-Eastman testified recently before the Subcommittee on Fossil and Synthetic Fuels of the Energy and Commerce Committee that they were pleased with the performance of the plant and that they would continue to produce methanol so long as the demand was there. Why is it necessary to spend federal money to supplement these private efforts?

As a matter of law, the Energy Security Act did not establish the SFC to gather information, but to demonstrate "at the earliest feasible time the practicality of commercial production of synthetic fuels...". If, as the SFC admits, it is not now "feasible" to demonstrate the practicality of commercial synfuel production, the SFC should acknowledge that its mission cannot be accomplished. The SFC could help Congress focus research and development efforts where they are needed.

It is not the SFC's job to do fossil fuel research. The Department of Energy has a large fossil fuel research and development program for which this Committee recently authorized $324 million, $51 million more than was requested by the Administration. If what we need is more fossil energy research and development, what we do not need is to be subsidizing commercial synthetic fuel plants.

If we are serious about reducing government spending and the budget deficit, I can think of no better candidate than the SFC. The Department of Energy is fully capable of monitoring the projects which have been awarded contracts by the SFC. Continuing the SFC is bad fiscal policy and bad energy policy.

Mrs. Lloyd. Thank you, Mr. Chairman.

Mr. Fuqua. Mrs. Schneider, do you have any questions?

Mrs. Schneider. I was just wondering, what were your proposals for the remainder of the money that you are not suggesting being used for the various alternative energy proposals?

Mrs. Lloyd. In the basic portfolio there is a subtotal of $10.9 billion, in the basic portfolio.

Mrs. Schneider. OK.

Mrs. Lloyd. The recommended portfolio is 10.9, is included in the DOE authority for Great Plains and Union, 1.1., and then basically transferred to DOE for direct liquefaction scale up is 1.7; so this leaves 8.1 in the synthetic fuels obligational authority. And that leaves $3 billion in the ESA contingency fund.

Mrs. Schneider. Three billion for a continuation of the Synthetic Fuels Corporation's activities or——

Mrs. Lloyd. No; this is——

Mrs. Schneider. For a continuation of your continued——

Mrs. Lloyd [continuing]. The contingent—in the contingency fund.

Mrs. Schneider. That is proposed in this legislation.

Mrs. Lloyd. 8.1 goes to SFC.

Mrs. Schneider. OK.

And you are content with keeping that 8.1 with the Synthetic Fuels Corporation because, as you know, there are other pieces——

Mrs. Lloyd. I think that—that is a minimum program.

Mrs. Schneider. OK.

You don't support the legislation on the part of the President's, that is suggesting the——

Mrs. Lloyd. No; I do not.

Mrs. Schneider [continuing]. Return of those dollars? Nor do you support the other legislation that suggests that we not have a Synthetic Fuels Corporation altogether?

Mrs. Lloyd. No; I do not.

Mrs. Schneider. How about the legislation that suggests that we earmark 25 percent of the money from the Synthetic Fuels Corporation to be used for district heating and cooling and also for trash to energy technology.

Mrs. Lloyd. I think that basically what I have outlined is the proposals that I would make, and I think it is a valid—it is a valid program. As I stated in my program, I think that these objectives are clear, and I think that they are worthy of support.

Mrs. Schneider. OK, thank you.

Mr. Fuqua. Thank you.

Mrs. Schneider. Thank you, Mr. Chairman.

Mr. Fuqua. Mr. Durbin?

Mr. Durbin. No questions.

Mr. Fuqua. Thank you very much——

Mrs. Lloyd. Thank you very much, Mr. Chairman.

Mr. Fuqua [continuing]. Marilyn, for being here this morning, we appreciate your statement.

Mrs. Lloyd. Enjoyed being with you.

Mr. Fuqua. Our next witness is also a member—colleague of ours on this committee, and chairman of the Subcommittee on Science Research and Technology, and also has been very interested in a matter of coal technology, and Congressman Doug Walgren. Doug, we are glad to have you here this morning.

STATEMENT OF HON. DOUG WALGREN, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF PENNSYLVANIA

Mr. WALGREN. Thank you very much, Mr. Chairman and members of the committee.

I appreciate the opportunity to join you this morning in discussing the present status of the Synthetic Fuels Corporation, and especially to make a formal appearance to emphasize my support for Mrs. Lloyd's legislation with respect to the use of coal.

As you will recall, I was here to testify with Mr. Rahall in March to urge support for the National Coal Science, Technology, and Engineering Development Act, known as 5044, and given the limitations of the budget room that we are—are working with, it is understandable that those recommendations were not able to be picked up in full by the—by your committee in the DOE budget.

But Mrs. Lloyd's bill builds on the concepts of that legislation and especially I want to underscore the importance in her bill of the 5-year coal research program and the mandatory private sector cost sharing for the demonstration programs that are anticipated therein.

Unlike the bill which I was sponsoring, H.R. 5593, which provided separate appropriations for these efforts, Mrs. Lloyd's bill transfers $1.85 billion from the Energy Security Reserve to the Department of Energy to manage new technology demonstration programs and, therefore, she would spend no—at least presently earmarked Federal money. Spending some of the money earmarked for synthetic fuels development on small-scale demonstration projects makes a great deal of sense to me, since bringing these technologies to the stage of commercialization meets the same goal and really provides the same degree of energy security, as does a barrel of oil anticipated to be produced by the Synthetic Fuels Corporation—it reduces our reliance on foreign oil.

I think it is clear that there are two principal reasons that the Synthetic Fuels Corporation ran into substantial difficulties—neither one of which, in my view, justifies the position taken by the administration of simply not going forward with the Synthetic Fuels Corporation.

First, we have seen another in a series of—of—of loss of confidence of management through conflict of interest and—and questionable relationships among the—the administrators in the Synthetic Fuels Corporation. And we know nothing can bring a major project in the administration of public moneys to a more grinding halt than these kinds of—of questions.

And, second, looking back with the benefit of hindsight, I think we can see that we tried to do too much and too soon. I think we ought to approach the commitment we made in the late 1970's to the Synthetic Fuels Corporation with an eye of making midcourse adjustments wherever those adjustments make sense. Because of the crisis atmosphere which surrounded the creation of the Corporation, the first solution that immediately came to mind was the wartime German liquefaction technology; and certainly that is especially appropriate for Defense Department needs and the like.

But now we know of the promise of other and often simpler technologies such as finely clean coal mixtures for the general use in the society. And as we look back, we can see the limitations of the Corporation which was not really set up to respond to a variety of technologies.

Many of these new promising technologies have stagnated in the process of development in the intervening years because the Department of Energy has chosen to limit itself so strictly—and underline the word strictly, to basic research. And with the Synthetic Fuels Corporation restricted to funding only proven commercial technologies, there simply was a wide gap, a technology demonstration gap which to this day threatens to stalemate any further development in many important areas of coal research, and especially in thinking of coal in the environmental area.

We have a national interest in finding ways to burn coal cleanly—an interest that goes beyond whether or not a particular technology can bring short-term profit. And that is why some role of Government and some leadership of Government is so important.

I think we have seen a lot of progress in the position of the Department of Energy in this area over the last year or so. Conversations I have had in the context of proposing the previous legislation with the Secretary and the Assistant Secretary of Fossil Energy very clearly indicate that there is some willingness in the administration to engage with the private sector in small-scale demonstration projects. This is a development in their thinking—a reaction to this gap that so clearly developed, that, I think, makes a great deal of sense, and one that there might be ready agreement on between the Congress and the present administration.

I know there is strong support for this kind and this level of program in the Senate. And with this committee's support, I think something that is a consensus program, that is a bipartisan program, has a great deal of opportunity for, in fact, being implemented.

And, while I believe we should use some of the funds from the Energy Security Reserve, I do feel that we should maintain the management of coal related projects at the Department of Energy. There has been, over the years, developed a talent and an administrative framework and capability in the Department of Energy that is not present in the Synthetic Fuels Corporation. We have good people there, especially at the Energy Technology Centers. They have deep and wide backgrounds, and experience in working in this kind of area—and I think it very important that that management, therefore, stay, even though we reach for funds that were previously anticipated to go strictly down the synthetic fuels route—that management should stay in the Department of Energy and not be diluted.

And finally, I would like to say that it would be wrong, in my view, to dismantle the Synthetic Fuels Corporation completely, because it has been managed badly, or because we should be making midcourse corrections, and—and including some of the other technologies that have some more immediate potential. Just because we should be making those kind of corrections is no need to, or reason to cut off our nose to spite our face.

Our need to develop domestic energy supplies in this country is no less real today than it was 4 years ago, and, certainly, we ought to maintain the Government responsibility in that area.

Mr. Chairman, I would like to ask to include in the hearing record a recent Washington Post editorial which underscores and endorses the role of Federal assistance for industrial scale development and demonstration of coal technologies, with the conclusion that subsidies for synthetic fuel production are a very real insurance, a very real present factor in where the market price of world oil goes, in view of what we are intent on doing in this country and, therefore, a good investment for public funds and for our attention.

Thank you very much, Mr. Chairman.

Mr. **Fuqua**. And without objection, the referred to article will be included.

[The article follows:]

[From the Washington Post, June 4, 1984]

A FOOTNOTE ON SYNFUELS

The attacks on oil tankers in the Persian Gulf bring, inevitably, renewed speculation on the possibility of American military intervention. That in turn, invites attention to a less dramatic event here in Washington last week. The Reagan administration demanded that Congress revoke most of the money it had earlier extended to the U.S. Synthetic Fuels Corporation. That unfortunate and mismanaged enterprise is becoming the great symbol of the muddle and inconstancy of American energy nonpolicy.

It was created in response to the last disruption of the world's oil supply by the Iranian revolutionaries. Now the Iranians are at it again, as well as their neighbors and enemies the Iraqis, and this time the response by the administration is to try to cut off all further development of synthetic fuels.

Perhaps by this time it doesn't make any difference. Perhaps the Synfuels Corporation has been so abused by poor appointments and poor judgment over the past three years that it is no longer capable of the job. The secretary of energy, Donald Hodel, may conceivably be right when he says that the only way to save the corporation is to cut it radically.

But its only major project, as things stand, is a plant to make gas out of coal. Synthetic gas is one product that the country doesn't really need. There's plenty of natural gas. What's needed is liquid fuel from coal—a subsititute for gasoline and heating oil.

The administration observes that the prices of some of the synthetic products would probably be excessive. That's true. The way to get the prices down is to undertake development of these technologies on an industrial scale. Even though the cost may be high in the early stages, it will be carefully noted in the Middle East and set an upper limit to market prices for oil. Subsidies for synthetic fuel production are a kind of insurance. In view of recent developments in the Persian Gulf, it doesn't look like a bad way to spend public money—especially when you consider the alternatives.

Mr. **Fuqua**. Doug, thank you for a very, I think, very excellent statement.

If I understand you correctly, you mentioned some of the faults and questions that you had about the Synthetic Fuels Corporation. Do you think it has been the defects in the law or the way that the law has been administered by the Corporation that has caused some of the—some of the problems?

Mr. **Walgren**. Well, in my view, the target that preoccupied us in the late 1970's is too narrow and, in fact, our best interests have moved somewhat, or broadened. I think we realize we have more time in many ways than we felt we had then. I think we are farther down the road to be able to—to realize the potential of some of the more diversified ways of using, in this instance, coal. And, in fact, the actual realization of the benefit of using some more diversified technology is more real today than it was then. And I think we ought to adjust our sights in view of that.

Mr. **Fuqua**. And in the technology demonstration area, I assume that you are referring to something that would be of a modular size, that if it is successful that then other modules could be developed along those same scales?

Mr. **Walgren**. Yes. I believe that we ought to be reaching a consensus with the administration on what they are talking about—semiworks.

Mr. **Fuqua**. Uh-huh.

Mr. **Walgren**. And trying to fill this demonstration gap that need not necessarily go to the full-scale industrial size in view of the administration's reservations about reaching that level.

Mr. **Fuqua**. Uh-huh.

Mr. **Walgren**. But there is so much common ground before we get to that point, that we ought to be taking them up on—on what we can both recognize as needs, and going substantially beyond the laboratory bench. And in my conversations with them, there is a substantial ground that would be certainly good for the country to pursue.

Mr. **Fuqua**. Thank you.

Mrs. Schneider.

Mrs. **Schneider**. Mr. Walgren, I, too, would like to ask you about your thoughts on the possibility of rather than appropriating additional funds for the projects that you mentioned, to, instead, use some of the money from the Synthetic Fuels Corporation?

Mr. **Walgren**. I think money from the Synthetic Fuels Corporation certainly is a ready pool and—and if we can reach agreement in a way that would satisfy both those who remain committed to the Synthetic Fuels Corporation and those who see the potential for using those funds in a little bit more broadly based fashion, that, certainly, is—is the first target for funds.

Mrs. **Schneider**. Two of the problems that one encounters in dealing with coal combustion—one is coming up with a cleaner combustion technology; and the second one, of course, is dealing with the cost in finding new markets, too.

I wonder if you could elaborate a little bit as to the technologies that you are mentioning in this bill and how they would address those two parameters of reaching new markets and the potential for burning in a clean fashion?

Mr. **Walgren**. Well, without being terribly specific, the—the technologies that will burn coal cleanly can be packaged in a number of ways that would make them widely usable in the society, even to the point of retrofitting our present burning capacity that uses only oil and the like.

The fluidized bed—and I would—I would encourage every member of this committee to visit Georgetown and go up on the football field and put out your hand and you will be standing next to the, literally, the emission source of a—of a clearly clean burning fluidized bed—the process that uses some of the most difficult coal that is trucked in from my part of the country, just for demonstration purposes.

So it is very clear that—that there is just such a host of varying applications of coal. And that is as it should be, because coal is such a basic plentiful resource that this country has, that if we can only master this problem of burning it in a clean fashion that is not mystery to us but—but things that we are able to really approach in the physical world today, we will have a much better energy base for the country.

Mrs. SCHNEIDER. As you are probably aware, the Capitol, and the House and Senate buildings themselves are reliant on district heating and cooling. And also Germany and many other European countries have been very successful in utilizing this technology.

Would you consider adding an additional category to your proposed legislation to include district heating and cooling?

Mr. WALGREN. Well, I certainly would love to talk about that. We have a district heating and cooling effort in Pittsburgh, and it is a very successful effort. Certainly, this kind of—of, of grouping together of consumers, essentially, is—should be a—a real target for what methods of burning that we can reach agreement on, ought to be funded by the Federal Government.

My feeling for the range of application of coal is that they need not be solely limited to—to this format. But certainly, for example, a district like mine in Pittsburgh, if they were able to come up with a—a kind of proposal that would fit with the demonstration projects which—which would be the ones that should be done under this bill, district heating and cooling should—should, should be a primary consumer of this kind of technology.

Mrs. SCHNEIDER. OK. Well, perhaps you and I can discuss this a little bit further and see if we have that opportunity to make sure that it is included either in one way or another.

Mr. WALGREN. Thank you.

Mrs. SCHNEIDER. Thank you.

Mr. FUQUA. Thank you. Mr. Boucher.

Mr. BOUCHER. Thank you, Mr. Chairman.

I, too, want to commend our colleague from Pennsylvania for his very thoughtful statement. I find myself entirely in agreement with the views that he has expressed.

Doug, I understand that there is about 14 billion available for the Synthetic—Synthetic Fuels Corporation today. I wonder what level of that funding you would think would be appropriate for diversion to the kinds of demonstration projects that you have discussed?

Mr. WALGREN. The amounts of money we are talking about don't approach the $14 billion. That was such a major commitment that we made at that time that the amounts that we could, I think constructively, and also within the agreement that we could reach. And I think the important thing is to extend ourselves to each other so that we do get an agreement and a consensus would not be on that level. And I don't think anybody who is interested in this area would be accused of being greedy, when we talk about bills that propose expenditures in the range, as Mrs. Lloyd has, of $2 billion—our bill was less than half of that. And yet, these would be major, major—would break major new ground compared to what we are doing now with respect to coal. So, there ought to be room for agreement on that amount.

Mr. BOUCHER. I think your bill also sets up a plan for the Department of Energy to conduct various phases of its research activities, and I think your time schedule is something like 5 years. I assume that you are still advocating that approach and would like to see that approach implemented with funding on the range of something under $1 billion up to about $2 billion from the synthetic fuels moneys.

Mr. WALGREN. I think that would be a major step forward. And—and the 5-year concept is so important for the way we govern ourselves, whether it be—because we need a road map. As Congressmen, we need a way to measure whether we are making progress and—and where we—reasonable people can expect to be 2 years down the road.

And that's why the provision in Mrs. Lloyd's bill of a 5-year research plan that can be tracked and—and kept on track, is so important.

Mr. BOUCHER. Just one final question. One of the projects that I think that holds tremendous promise is coal/water mixtures which can be substituted directly for oil without industries and utilities incurring major conversion costs.

I know that the legislation which Representative Rahall has submitted, which is somewhat similar to yours, contains a direction that the Department of Energy fund a coal/water demonstration project. And I wonder if you would have any objection to that should your bill be reported by the subcommittee?

Mr. WALGREN. No, I want to be encouraging of that, because I think that is one of the ways that you bring substantial increased use of coal on in the near term, because you can literally bring it to small presently existing industrial facilities.

One of my great disappointments in the several years that I have been in the Congress is that we had proposals for just that, without major retrofitting because of the—the—the way the coal would be used. We could simply plug in and add onto the plant that would literally bring coal in one end and—and run it into a—into a system that presently burns oil. And that was just unfunded in this process that we have gone through.

So I think we've learned some—some real lessons of omission in the last several years that we ought to—to know, are things that we should do together governmentally.

Mr. BOUCHER. Thank you very much. Thank you, Mr. Chairman.

Mr. FUQUA. Thank you. Mr. Lewis.

Mr. LEWIS. No questions, Mr. Chairman, thank you.

Mr. FUQUA. Thank you very much, Doug, and we appreciate your contributions in being here this morning.

Mr. WALGREN. Thank you very much, Mr. Chairman.

Mr. FUQUA. Our next witness is a former member of our committee and one who has been very interested in making some significant modifications at the Synthetic Fuels Corporation, our colleague, Howard Wolpe. Howard, we are very happy to have you with us this morning.

STATEMENT OF HON. HOWARD WOLPE, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF MICHIGAN

Mr. Wolpe. Thank you very much, Mr. Chairman.

I want to begin by commending you both for holding this important hearing today, and for the strong leadership that you have provided in the past on behalf of a sound fossil energy research and development program.

I would also like to thank you for the opportunity to once again participate in the proceedings of the subcommittee. It was as a member of the subcommittee in 1979 that I first became involved in the debate concerning our Nation's policy for the development of synthetic fuels. And I look forward to rejoining the subcommittee following my temporary service on the Budget Committee.

The Synthetic Fuels Corporation was established in response to the long gasoline lines that followed the tumultuous 1979 Iranian revolution. Its goal was to create a commercially viable synfuels industry in the United States with the $15 billion that it had at its disposal.

However, if we have learned anything since the creation of the SFC, it is that synthetic fuels will not be commercially viable for the foreseeable future. The private sector has virtually abandoned commercialization activities as project after project has folded due to insurmountable technical and economic problems.

In an interview in a Colorado magazine, Mr. Earl Hurst of Chevron Oil Shale summed up the industry's lack of interest in the commercialization of synthetic fuels. I would like to quote him.

> The industry doesn't do it today because we don't have the technology or see the market. You can see by the projects that folded, they didn't have the technology right. Demonstration size, research and development are a must before you move into full-scale operation.

If the SFC is allowed to resume with its plans to make $10 to $15 billion in awards to fund the premature commercialization of synfuel technologies, the taxpayer will be forced to spend billions of dollars for projects that will provide very little, if anything, in return. These projects would produce petroleum substitutes at a cost of $60 to $90 per barrel, products that obviously cannot compete in the marketplace with oil selling at $29 per barrel.

As an aside, Mr. Chairman, I would like to note that its recently come to my attention that the SFC now claims that the Federal subsidy to produce $67-per-barrel shale oil in Colorado really only amounts to a subsidy of 11 cents per barrel. I would urge you to examine these kinds of claims very closely.

I am reminded of an article that appeared in the New York Times on September 28, 1983, that contained this story: "SEC Files Suit Against Fuel Unit." And it goes on to report that the Security and Exchange Commission said that it had filed charges in Federal court against a synthetic fuel company charging them with fraud in a scheme involving misappropriation of up to $3½ million from the sale of its stock. It said that the officers of this company had publicly demonstrated something known as the Wallace Process Converter which turned coal into oil, but used a hidden tank that had been filled with oil to make the device's productive capacity appear twice what it actually was.

In light of this item, and I think we have had other comparable examples, I hope we will all be wary of any salesman who tries to sell us a black box that will produce $67 snake oil for only an 11-cent subsidy per barrel.

Many supporters of the SFC can see that the cost of the taxpayers will be great. But they insist that the SFC spend the billions of dollars at its disposal because we may gain some knowledge that could contribute to energy security.

However, it must be understood that the SFC itself was never intended to help us learn anything. As you know, the Corporation is actually prohibited by law from supporting research and development activities that could increase our store of knowledge.

The SFC was designed to serve strictly as a bank to create a commercially viable industry by dispensing subsidies to mature, economically viable projects. But if mature, economically viable projects are not available, should we allow the Synthetic Fuels Corporation to squander billions of taxpayer dollars on the premature commercialization of second rate projects that will provide very little in return?

I think the answer to this question is obvious. Allowing business-as-usual to resume with the SFC would make no sense in terms of sound fiscal policy or sound energy policy.

I am convinced that such an ill-advised effort would actually prolong our Nation's energy vulnerability. It would delay the development of a commercially viable synfuels industry by diverting limited public and private funds away from much needed research and development efforts that could in fact contribute to the commercial viability of these technologies when the energy marketplace is more favorable.

It is clear, I think, that the House of Representatives is opposed to the continuation of business-as-usual at the Synthetic Fuels Corporation. Over half of the Members of this House, 229 Members, have not cosponsored H.R. 4098, the Synthetic Fuels Corporation Fiscal Accountability Act. As you know, the majority of the members of this committee and of the other two committees to which my legislation has been referred, have joined as cosponsors of this bill.

Our bill would not abolish the Corporation but it would prohibit the Synthetic Fuels Corporation from making any further awards until the Congress has reassessed the program and approved the Synthetic Fuels Corporation's strategy for the future.

I am pleased that the President has responded to congressional pressure and proposed legislation to reform the SFC. I am also encouraged by the President's decision to refrain from making nominations to fill vacancies on the scandal-ridden SFC Board of Directors until Congress has passed this legislation.

In essence, we now have the moratorium on SFC spending that H.R. 4098 seeks to achieve. We now have the opportunity and the obligation to engage in a comprehensive reassessment of the goals and future direction of our Nation's Synfuels Development Program.

The reform proposal that the President has announced is a step in the right direction. But I strongly believe that any reexamination of the SFC should address the following points:

First, the funding level. The President's proposed funding level of $5 billion, in my view, is simply too much money. In light of the massive deficits that threaten the health of our economy, I believe that we must fashion an efficient synfuels development program that would contribute to both energy security and permit further reductions in Federal spending.

Second, research and development. After the SFC's funding level has been reduced, a substantial portion of the remaining money should be transferred to the Department of Energy to fund a stepped-up research effort to develop liquid fuels from coal. The remaining funds at the SFC's disposal should also be made available for funding research and development activities. If such activities were to include support for demonstration size, research, and development projects, then the Federal Government should require at least a 50–50 cost-sharing arrangement with private industry.

With respect to commercialization, if any commercialization projects are envisioned, they must be subject to a strict market test to guarantee that the products of such a venture would be competitive in the marketplace.

And finally, with respect to accountability, all SFC funding should be on-budget and subject to the annual authorization and appropriations process.

In addition, provisions in the Energy Security Act—excuse me—exemption the SFC from the Freedom of Information Act, from the Government in the Sunshine Act, from Federal pay scales, and from conflict of interest in financial disclosure laws, must be eliminated. There is simply no excuse on earth to allow the Synthetic Fuels Corporation to continue to operate as a totally unaccountable venture without any ability of the Congress to exercise the kind of controls and oversight that it applies to virtually every other Federal agency.

One last point with respect to the monitoring and data collection program. A memorandum of understanding should be drawn up between the Synthetic Fuels Corporation, the Department of Energy, and the EPA. This agreement would give the DOE and the EPA the authority and the responsibility to establish and maintain a comprehensive monitoring and data collection program for all demonstration and commercial projects receiving Synthetic Fuels Corporation assistance.

This program would monitor the progress and accumulate the data related to a project's technical performance, its economic viability, and the environmental and socioeconomic impacts of contemplated projects.

As I stated earlier, the current situation at the Synthetic Fuels Corporation should be viewed as an opportunity to engage in a comprehensive reassessment of our Nation's Synfuels Development Program.

I would welcome the opportunity to work with the members of this sub—of this committee as we begin this important process.

Thank you very much, Mr. Chairman. I would, of course, be pleased to respond to any questions.

Mr. **Fuqua**. Thank you very much, Howard, for a very well thought out statement.

The—since the position of—of the bill that you have sponsored and the position of the administration appears to be somewhat paralleled, is the administration supporting your bill?

Mr. **Wolpe**. The—there has been no formal statement of support. We have received letters that clearly indicate their—that they are, I think, in concert with the goal of the legislation. We had written—a bipartisan letter went out from members of the Senate and House Budget Committees urging the President, even in advance of the most recent announcement, to use the authority he had to defer further SFC spending.

And in response to that letter, the White House indicated a sympathy with the objectives that we were trying to achieve at that point, but questioned whether it had a legal authority as of that juncture.

Mr. **Fuqua**. You mentioned one part that—that the SFC had no authority to do any research, and that was prohibited. And the reason that was prohibited was that we didn't want to create two agencies doing research where the Department of Energy was already mandated to do that—have them do the research, the—after it was proven, then the SFC would—would take over. So that was by design so that we didn't have a duplication of a lot of R&D projects where the so-called snake oil salesman may go—may be turned down by one and may be successful at the other.

Mr. **Wolpe**. If I could respond to that, Mr. Chairman.

Mr. **Fuqua**. Sure.

Mr. **Wolpe**. That is correct, but at times the advocates of the Synthetic Fuels Corporation try to have it both ways. You are quite correct—the legislation was designed not as a research and development effort——

Mr. **Fuqua**. Uh-huh.

Mr. **Wolpe** [continuing]. But simply to subsidize what was supposed to be commercially viable projects. It turns out now that the projects, as we all know, are not commercially viable. The Corporation had enormous difficulty identifying doable projects, they keep lowering their criteria for issuing of letters of intent, and so on.

Mr. **Fuqua**. Uh-huh.

Mr. **Wolpe**. Now the argument that is being advanced is that we need to continue the Synthetic Fuels Corporation so we can learn more so we can develop the technology for the future. In other words, finally, there is an acknowledgement that we don't know enough yet to commercialize these technologies.

Well, if indeed we don't know enough, then our focus should be still on research and development, delaying the commercialization for the future. And I would argue that it is this committee, and it is the Department of Energy, that have the proper jurisdiction over research and development, and that it is those institutions that are properly equipped to—to handle that.

Mr. **Fuqua**. But we are have run into a—a conflict with the philosophy of this administration, that they do not want to support any demonstration projects.

Mr. **Wolpe**. Well, I have a feeling, as has been suggested by previous witnesses, by Mr. Walgren in particular——

Mr. **Fuqua**. Uh-huh.

Mr. **Wolpe** [continuing]. That there may well be a change of mind in recognition that this—this SFC effort was so grandiose, and so massive in scale, as to be totally worthless, that now we better perhaps ought to look at smaller scale projects that would have much more of a research and development thrust up front.

Mr. **Fuqua**. Right.

Mr. **Wolpe**. I think that is something that should certainly be explored with the administration.

Mr. **Fuqua**. Thank you very much.

Mrs. Schneider.

Mrs. **Schneider**. If I can interpret where we are right now, it appears that the onus of responsibility is on the Congress at this time to determine exactly what the Synthetic Fuels Program ought to be and what the status is of the Synthetic Fuels Corporation. We need to do this, it is my understanding, before the President will appoint any new members to the Board.

What action do you see Congress taking, and how soon?

Mr. **Wolpe**. Well, my understanding is that the administration has introduced its—a bill to implement the proposed reduction of some $9 billion in SFC funding. That legislation can become a vehicle for this debate. Congressman—there has also been legislation that has been introduced to abolish the Corporation, as I understand it. There are—and then my own bill calling for the moratorium on funding and for the congressional review. All provide appropriate vehicles.

I would hope that one of those vehicles will be selected and that we will begin that process of really trying to come to terms with what we want in terms of energy policy and how the concept of the Corporation can mesh with our overall energy policy.

The concern that I have is twofold. One is, we really haven't established any criteria for how we use Federal dollars. We allocate moneys on a very much of an ad hoc basis without any kind of criteria as to what research and development investments will yield the greatest payback. How can we most quickly; how can we most cheaply, displace petroleum? That ought to be, I think, the—sort of the—the target question around which we ought to frame this analysis.

And then, second, having decided that, how can we create a mechanism with the greatest accountability, so we avoid the extraordinary scandal and competence and difficulties that have characterized the SFC's operation.

Mrs. **Schneider**. So in terms of timing, we are suggesting that the likelihood of any action on the Synthetic Fuels Corporation insofar as any future expenditures of dollars probably won't be until next year?

Mr. **Wolpe**. Perhaps. I think—I certainly think there still is enough time within the Congress if there's the will on the part of the committees of jurisdiction to take up this legislation this year, any of those bills that—to which I referred.

But I don't pretend to be highly optimistic that that will happen at this juncture.

Mrs. **Schneider**. OK. Thank you very much. Thank you, Mr. Chairman.

Mr. **Fuqua**. Thank you. Mr. Boucher?

Mr. **Boucher**. Thank you, Mr. Chairman.

I would like to ask you, Howard, if you have a figure in mind for the sums that should be allocated to the Department of Energy for research on developing liquid fuels from coal?

I was very encouraged to hear you mention that you support that approach. I wholeheartedly support it as well. But I would be interested in hearing a dollar figure if you have none in mind.

Mr. **Wolpe**. Not with any precision. I would certainly think a $300 to $500 million additional allocation would certainly be warranted—but—at this point. But that's a very—kind of, really a very quick kind of suggestion, and I don't have any careful rationale for those particular numbers.

I—I mention that figure, however, in order to emphasize that I do believe that we ought to continue and indeed accelerate a research and development effort.

At times it has been suggested that the opponents of the Synthetic Fuels Corporation are opposed to the development of synthetic fuel technology. Nothing could be further from the truth. We clearly do need to have in place the capability of producing synthetic fuels at a time when they can be in fact commercially viable.

I, therefore, want to make very clear my own support by indicating support for increased allocation for research and development for that purpose. Clearly, the dollar amounts that can be usefully employed at this stage are far less, far, far less, than we are trying to waste through these subsidies going to the commercialization process.

Mr. **Boucher**. Let me ask, too, I was pleased to hear you suggest, and I agree with your suggestion, that the Department of Energy perhaps needs more guidance and the establishment of targets for the commercialization of particular technologies over a stated period of time.

I think that approach would clearly advance the efforts that we're undertaking now. That is the approach that is assumed in Representative Walgren's bill, in legislation pending here also introduced by Representative Rahall and in Mrs. Lloyd's bill.

Do you support that approach as well, and do you think that that kind of targeting over a stated period of time, be it 5 years or somewhat longer, would accomplish the results you are seeking?

Mr. **Wolpe**. The only caveat that I would make is my comment about the establishment of criteria and targets related to our overall approach to energy policy, both in terms of research and development and in terms of commercialization.

I have served on this committee, and I know how ad hoc our decisions frequently were. We would allocate R&D dollars just as we allocate commercial subsidy dollars, not on the basis of a careful analysis of potential economic impacts and relative tradeoffs, but much more on the basis, frankly, of political pressures. If you have an effective lobbyist and an effective strongly enthusiastic advocates within the committee, or outside of the committee within the Congress, that frequently is more determining of who gets what than any kind of real analysis of what our energy requirements are, and how they can most cheaply and efficiently and in the most environmentally benign way be met.

So I am trying to suggest that we ought to look at not only coal in a vacuum, but we ought to look at all of the use of coal, but at all of the available technologies out there, and try to develop a much more rational reasoned approach as to how we make these decisions.

Mr. BOUCHER. Would you agree, though, that at least within the area of coal, that the approach recommended of setting 5-year targets and looking at particular projects to be developed over that timeframe would be a constructive way to address that problem?

Mr. WOLPE. Yeah. Well, let me just point out, and I don't—I would like to be able to give you an easy affirmative response to that, because I think there is much of merit in particular in Congressman Walgren's proposal that I could support. Having said that, the SFC did set targets. They simply haven't worked because the targets were unrealistic in the first instance because the underlying economic analysis never made any kind of sense.

That's why I come back to this first question: What are the economics? What's the rationale for how we make our determinations in the first case, in the first instance?

Mr. BOUCHER. OK; thanks very much. Thank you, Mr. Chairman.

Mr. FUQUA. Thank you, Mr. Boucher. Mr. Lewis.

Mr. LEWIS. Thank you, Mr. Chairman.

Mr. Wolpe, thank you for the fine testimony. And reading your bill, I certainly feel the bill has a lot of merit but I just wonder if you haven't gone far enough. With your print 3 and print 4 in the bill, I just wonder if where we have not improved the security of the Nation, and where we don't have any original production goals that if we spent all the $15 billion we still wouldn't meet the original production goals—I just wonder if—what your general overall feeling is for the need for the Synthetic Fuels Corporation.

Mr. WOLPE. Well, I——

Mr. LEWIS. Does your bill go far enough?

Mr. WOLPE. I should indicate that earlier I was a cosponsor of legislation to abolish the Corporation. I think the decision to establish the Corporation was premature; I don't think it has done anything but waste lots of money.

Having said that, and I think that I would much rather see a portion of these dollars allocated to the Synthetic Fuels Corporation go to, as we have been discussing, enhance research and development of these technologies.

My major concern at this point is that if the political realities of this institution dictate a continuance of the Corporation, and they may, then I am concerned that we at least get very—get much more reasonable in terms of the kinds of dollars that are allocated for this effort, No. 1.

And, second, that we put in place mechanisms of—to ensure accountability. I mean, this creature that we have established out there is exempt from conflict of interest laws, from the Freedom of Information Act, from financial disclosure requirements, from—from everything that we normally take to be about the minimum requirements for public agencies; that's nonsense.

And so I guess what I am saying to you, if I had my preference I, frankly, would like to see the Corporation go totally out of existence. If it is to be continued, however, then I think minimally we ought to impose upon it some very clear criteria, reduce its allocation, and establish real accountability.

Mr. **Lewis**. Thank you, Mr. Wolpe. Thank you, Mr. Chairman.

Mr. **Fuqua**. Thank you very much, Mr. Lewis. And thank you, Howard, for being here this morning.

Mr. **Wolpe**. Thank you very much.

Mr. **Fuqua**. Our last colleague witness is Congressman Richard Durbin from Illinois, who has been very interested in—particularly in coal and the improved use of coal. Dick, we are happy to have you here, and appreciate hearing your testimony.

STATEMENT OF HON. RICHARD J. DURBIN, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF ILLINOIS

Mr. **Durbin**. Thank you, Mr. Chairman. I thank my fellow committee members for this opportunity to testify. I'd like to discuss briefly the status of the Synthetic Fuels Corporation along with the agency's future prospects, and then talk about one particular project which I think provides a good illustration of why we must not abandon the Federal commitment to the development of a viable domestic synfuels industry. Perhaps we need to reevaluate our strategy for attaining the goal of developing the industry but we must not abandon the effort.

If we believe that oil prices can't possibly go up, that the Middle East is a reliable and economic source for energy for the United States, and if we believe that energy innovation is a questionable investment, then, by all means, we should diminish our national commitment to the development of synthetic fuels.

But if we believe that the present domestic energy sources are limited, potentially expensive, and could drag us into a global conflict for our survival, then I urge some caution. The current crisis in the Persian Gulf demonstrates now more than any time since 1979, the critical need to develop alternative forms of energy. As long as we and many of our allies are dependent on oil from the Middle East, we will continue to be vulnerable to the volatility of the troubled political situation in that region of the world.

As a recent Washington Post editorial pointed out, "encouraging synthetic fuel production, doesn't look like a bad way to spend public money except when you consider the alternatives." Further efforts to promote energy independence are essential as the world is still feeling the repercussions from the last rapid jump in oil prices following the 1979 Iranian revolution.

The country took a major step toward the goal of energy independence when President Carter signed into law the Energy Security Act in 1980, which established the Synthetic Fuels Corporation.

The importance of developing the synthetic fuels industry as an alternative to imported oil was recognized well before 1980. The industry could not develop without Government help because the technology for creating this type of fuel from coal, oil shale, or other natural resources was prohibitively expensive. As a result, entrepreneurs were discouraged from investing on a commercial scale.

As early as 1975, President Gerald Ford backed proposals for Federal programs to encourage development and commercialization of synthetic fuels. And I might add parenthetically, that in 1966, when I worked for a gentleman by the name of Paul Douglas from Illinois, he started a national debate about the future of oil shale—it goes back far and probably even further.

By 1979, however, the need to develop the synthetic fuels industry became even clearer as the price of oil continued to skyrocket. The Congress acted quickly and convincingly to provide a Government role. By a 368 to 25 vote, an overwhelming vote, the House included an amendment to the Defense Production Act spurring synfuels development. It adopted the conference report on the final synfuels bill by a lopsided vote of 317 to 93.

The sentiment in the Senate was much the same. The Senate adopted the bill authorizing $20 billion for the first phase of synthetic fuels development in a 65 to 19 vote. During the debate, Senator Henry Jackson urged Congress to send what he called a strong signal to the world that we are taking a first step in developing synfuels technology.

Since its inception, the Synthetic Fuels Corporation has not fulfilled its original promises. The Corporation has not met the ambitious production targets set out in the Act. It has not spent much of the money that Congress appropriated. Allegations of mismanagement of the Corporation abound. The Board of Directors has lacked a quorum for a good part of the Corporation's existence. The Corporation has drawn much criticism during this time, so much so that over half of my colleagues in the House have agreed to cosponsor Representative Wolpe's SFC Fiscal Accountability Act.

Still, our energy situation has not changed fundamentally since the Corporation was established. The world oil industry now has at least a 10- to 20-percent overcapacity which has engendered, I am afraid, an atmosphere of complacency. However, this is a very fragile situation that provides little security for the long term.

In addition, many conservation measures adopted since 1980, including the shift to more fuel efficient cars, have reduced our dependence on oil. Yet, neither improved energy conservation nor the world oil glut have eliminated Western dependence on Middle East oil. The most recent Persian Gulf crisis has forced us to confront our vulnerability once again.

The Synthetic Fuels Corporation stands at a critical juncture. In my opinion, the time is ripe to adopt measures that will restore accountability to the SFC rather than reverse the overwhelming mandate given it by Congress in 1980.

There is an urgent need for strong leadership in developing the synthetic fuels industry—from the Synthetic Fuels Corporation, from the administration, and from Congress. The first step in restoring synfuels accountability is for the President to appoint, and the Senate to confirm, nominees, who both understand the energy industry and are sympathetic to the concept of business and government working together to develop that industry.

Two of the more notable examples of that cooperation have been considered by this committee—cooperation between Government and industry in the development of the space and computer industries. There is no reason why similar cooperation would not be successful in developing the synthetic fuels industry.

Above all, I would encourage the administration to appoint, and the Senate to approve, only those nominees who believe in the mission of the agency. It is hard to create enthusiasm for an agency when one of the few things the directors can agree on is that the agency should not exist.

I would like to mention briefly one particular project which has applied to the SFC for loan guarantees. I have become very familiar with it because it affects Illinois coal and may affect my district. I would like to discuss it to give you an example of where I think we should be headed in terms of commercialization.

I have become familiar with the project over the past few months and I think it provides a good example of the contribution that the synthetic fuels industry could make.

The project would take reserves of high sulfur coal, the coal that abounds in Illinois and West Virginia, and all across the Midwest, so-called dirty coal, and it would turn it into anhydrous ammonia in an environmentally safe manner, and that anhydrous ammonia could be used as anhydrous ammonia fertilizer.

There are many benefits involved in the project. First, it would use domestic reserves of coal, thereby giving a boost to a depressed industry. It would make good use of our own energy resources. It would free up large reserves of natural gas, which is now used to produce anhydrous ammonia.

Third, the Japanese are now close to completing construction on a similar coal gasification plant that will use Canadian coal to produce the fertilizer. Imagine, if you will, that they can import from British Columbia coal to Japan, convert it into anhydrous ammonia fertilizer, and sell it in the United States at a profit.

As we sit here and debate our commitment to synthetic fuels, as the board room of the Synthetic Fuels Corporation echoes in its emptiness, the Japanese move again with the cooperation between Government and industry into another area. Does anyone doubt that in a few years, if they are successful, we'll have an emergency bill before Congress on how to respond to this crisis, and how to keep out this Japanese fertilizer?

There is no reason why we should surrender this technology to the Japanese when we can use it ourselves.

The project that I described is also cost effective. Those of us from farming States can readily testify to the skyrocketing cost of ammonia fertilizer. The anhydrous ammonia generated from this high sulfur coal would be cost competitive with present market prices and would diminish our present need to import this product from the Soviet Union and Mexico.

In sum, this project, which has been put together by the business community, would put to very good use the government's contribution from the Synthetic Fuels Corporation. It represents an example of what the SFC could contribute to our energy future.

I would like to speak for just a moment on Mr. Wolpe's bill, which I have not—I am one of the few, I guess, who hasn't signed on as a cosponsor. I don't believe it is a step in the right direction. I think that bill would have a chilling effect on many projects such as the one I just described.

The people who are putting this venture together have been whipsawed by high-interest rates—imagine and remember, if you will, that the prime interest rate's gone up a point and a half since mid-March—and they are looking to the future, the project.

If we are going to put the whole Synthetic Fuels Corporation on hold until Congress approves some quarterly report and sets out a schedule, it cannot help but diminish interest in the project and it cannot help but, I think, kill many potentially good projects across this country.

Mr. Wolpe also talked about delaying commercialization and stressing research and development. I certainly support that. And this committee—I've worked with Congressman Boucher and the chairman on research and development and development of Illinois coal. But to walk away from the potential of helping potentially promising commercialized ventures such as the one I described, I think would be a serious mistake. And I hope that the Congress does not follow the suggestion of the legislation by the gentleman from Michigan.

I do support, however, completely, his suggestions of accountability. I think the Synthetic Fuels Corporation can be held more accountable and in that fashion have, I guess, a higher confidence quotient on Capitol Hill.

Again, thank you for the opportunity to address the committee, and I welcome any questions you might have.

[The prepared statement of Mr. Durbin follows:]

RICHARD J. DURBIN TESTIMONY BEFORE EDA SUBCOMMITTEE JUNE 6, 1984

I thank my colleagues and fellow committee members for giving me the opportunity to testify.

I would like to discuss briefly the state of the Synthetic Fuels Corporation, along with the agency's future prospects, and then talk about one particular project which I think provides a good illustration of why we must not abandon the federal commitment to development of a viable domestic synthetic fuels industry. Perhaps we need to re-evaluate our strategy for attaining the goal of developing the industry, but we must not abandon the effort entirely.

The current crisis in the Persian Gulf demonstrates now more than any time since the 1979 energy crisis the critical need to develop alternative forms of energy. As long as we and many of our allies are dependent on oil from the Middle East, we will continue to be vulnerable to the volatility of the troubled political situation in that region of the world. As a recent Washington Post editorial pointed out, encouraging synthetic fuels production "doesn't look like a bad way to spend public money, especially when you consider the alternatives". Further efforts to promote energy independence are essential, as the world is still feeling the repercussions from the last rapid jump in oil prices following the 1979 Iranian revolution.

The country took a major step toward the goal of energy independence when President Carter signed into law the Energy Security Act in 1980 which established the Synthetic Fuels Corporation. The importance of developing the synthetic fuels industry as one alternative to imported oil was recognized well before 1980. The industry could not develop without government involvement because commercializing the technology for creating this type of fuel from coal, oil shale, or other natural resources was prohibitively expensive. As a result, entrepreneurs were discouraged from investing on a commercial scale. As early as 1975, President Ford backed proposals for federal programs to encourage development and commercialization of synthetic fuels.

By 1979, the need to develop the synthetic fuels industry, along with other alternative energy technologies, became even clearer as the price of oil continued to skyrocket. During that year, the Congress acted quickly and convincingly to provide a government role in synfuels production. By a 368–25 vote, the House included an amendment to the Defense Production Act spurring synfuels development. It adopted the conference report on the final synfuels bill by a 317–93 vote

The sentiment in the Senate was much the same. That body adopted a bill authorizing $20 billion for the first phase of synthetic fuels development in a 65-19 vote. During the debate, Senator Jackson urged the Congress to send a "strong signal" to the world that we are taking a first step in developing synfuels technology.

Since its inception, the SFC has not fulfilled its original promise. The Corporation has not met the ambitious production targets set out in the original Act. It has not spent much of the money that Congress appropriated. Allegations of mismanagement of the Corporation abound. The Board of Directors has lacked a quorum for a good part of the Corporation's existence. The Corporation has drawn much criticism during this time, so much so that over half the House has agreed to co-sponsor Rep. Wolpe's SFC Fiscal Accountability Act.

Still, our energy situation has not changed fundamentally since the Corporation was established. The world oil industry now has at least a 10 to 20 percent overcapacity which has engendered an atmosphere of complacency. However, this is a very fragile situation that provides little security for the long term. In addition, many conservation measures adopted since 1980, including the shift to more fuel-efficient cars, have reduced our dependence on oil. However, neither improved energy conservation nor the world oil glut have eliminated Western dependence on Middle East oil. The most recent Persian Gulf crisis has forced us to confront our vulnerability once again.

The Synthetic Fuels Corporation now stands at a critical juncture. In my opinion, the time is ripe to adopt measures that will restore accountability to the SFC rather than reverse the overwhelming mandate given it by congress in 1980. there is an urgent need for strong leadership in developing the synthetic fuels industry—from the SFC, from the Administration, and from Congress. The first step in restoring the SFC's accountability is for the President to appoint and the Senate to confirm nominees who both understand the energy industry and are sympathetic to the concept of business and government working together to develop the synthetic fuels industry. Two of the more notable examples of cooperation between government and industry occurred in the development of the space and computer industries. There is no reason why similar cooperation would not be successful in developing the synthetic fuels industry.

Above all, I would encourage the Administration to appoint and the Senate to approve only those nominees who believe in the mission of the agency. It is hard to create enthusiasm for an agency when its leaders agree on only one thing—that the agency should not exist.

I would like to mention briefly one particular project which has applied to the SFC for loan guarantees. I have become familiar with the project over the past few months because of its potential impact on my state of Illinois, and I think it provides a good example of the nature of the contribution that the SFC could make.

This project would use reserves of high sulfur coal, which it would gasify in an environmentally safe manner, to produce anhydrous ammonia that is used as a fertilizer. There are many benefits in volved with this project. First, the project would use domestic reserves of coal, thereby giving a boost to a depressed industy and making good use of our own energy resources. Second, it would free up large reserves of natural gas which are now used to produce anhydrous ammonia. Third, the Japanese are now close to completing construction on a similar coal gasification plant that will use Canadian coal to produce the fertilizer. There is no reason why we should surrender this technology to the Japanese when we can exploit it ourselves.

The project is also cost effective. Those of us from farming states can readily testify to the skyrocketing cost of ammonia fertilizer. The anhydrous ammonia generated from this high sulfur coal would be cost competitive with present market prices and would diminish the need to continue importing this product from the Soviet Union and Mexico. In sum, this project, which has been put together by the business community, would put to very good use the government's contribution from the SFC. It represents an example of what the SFC could contribute to our energy future.

Again, thank you for the opportunity to address the Committee, and I welcome any questions the Committee might have.

Mr. FUQUA. Thank you very much, Dick, for a very excellent statement and I think a very reasoned statement. I gather from what you are saying that—that you, as I said in my opening statement, do not feel that the situation has changed since we originally created the Synthetic Fuels Corporation. And if the—if the Corporation is deficient, then its responsibility to the Congress to try to correct that, not throw it out the window just because somebody may be displeased, and maybe rightfully so, of some of the actions that have—that have taken place. But the fact remains that we are still in a very serious and critical energy situation, even though, as you pointed out, there is some reason to believe that the complacency exists because we have had an oil glut for the last—the market has. But the fact remains that we're still depleting the oil reserves here and elsewhere in the world. And that will come to haunt us in a—sometime in the very near future.

And I want to commend you. I think you made a very, very excellent statement.

Mr. DURBIN. Mr. Chairman, let me add, too, if we delay the resolution of this issue of the Synthetic Fuels Corporation, imagine the impact this is going to have on commercial ventures. If they cannot trust within a reasonably short period of time that this agency will be back in business doing what it was created to do, then what confidence do they have to go forward with the projects?

Will we not basically turn out the lights on many good ventures, potentially good ventures? And say a year from now we decide things are worse, and we are going to renew our commitment? We are going to lose at least a year and maybe two in the process. And who knows what the political situation in the world is going to be during that 2-year period of time?

Mr. FUQUA. Well, the regret that I have that in 1975 when we had the bill before the House, it was defeated by one vote to set up a similar type synthetic fuels business. People perceived the oil situation as a contrived scam against the public and reflected that in your Congressmen, and it was defeated by one vote.

We then went back to the drawing boards and it was only until 1979 that the House passed the first bills in modern times. We started one after World War II, and it was killed in the early fifties out in Missouri. So we—we've been up and down this path long enough. I hope we can—we have learned our lesson that we better get moving or else we will find ourselves in a very serious predicament.

Mrs. Schneider.

Mrs. SCHNEIDER. No questions.

Mr. FUQUA. Mr. Boucher.

Mr. BOUCHER. Thank you, Mr. Chairman.

Like Congressman Durbin, I, too, have refrained from becoming a cosponsor of the Wolpe bill, and I support the approach that Mr. Durbin is suggesting to us today.

I'd like to ask, though, I noticed that most of the witnesses who have testified this morning have suggested that even if we leave the Synthetic Fuels Corporation intact and work to see that new board members are appointed so that it can go on about its mission, that it would be useful for some of the moneys that are presently appropriated for the Synthetic Fuels Corporation to be expended by the Department of Energy in new coal combustion technologies—coal cleaning technologies, coal/water mixtures, and the like. Anywhere between $3 to $500 million, and $2 billion has been suggested as a proper diversion of synfuels funds to DOE for those purposes.

I share that point of view, and I would like to hear your comments as to whether you think that's a course we should pursue.

Mr. **Durbin**. I would think that one of the deficiencies of the Synthetic Fuels Corporation and one that they acknowledged earlier this year was the fact that they had really not put enough emphasis on coal. Some of the projects which were approved this year in 1984 have related to coal. And I think they finally realized that this is an energy source that should become a focal point.

I'm not very good at apportioning the dollars as to how much should go to each industry. You and I sit here and scramble fighting other energy sources to make sure that the R&D on coal continues.

But I think that the agency was starting to realize that from the national—the viewpoint of the national interest, that there had to be a greater commitment of the Synthetic Fuels Corporation toward coal.

I would just say that I have some hesitancy from a policy viewpoint for us to sit here and apportion by percentage which potentially promising ventures will be funded. We may find ourselves binding that agency to a commitment to fund and do—a project of dubious utility relating to coal when there may be one right next door with another energy source that is much more promising.

We are in a dilemma. I think perhaps Congressman Wolpe made a good suggestion, that if there was some accountability through the appropriations process we could at least bring the directors of the agencies before us on a regular basis to explain the basis of their decision, and then ask them, why didn't you move more toward this area or that area, and see if in fact it was a sound decision. That might give us the mechanism for an oversight without tying their hands within the legislation.

Mr. **Boucher**. It just seems to me that the agency that is most likely to develop commercial technologies that help coal substitute for oil more immediately is the Department of Energy as opposed to the Synthetic Fuels Corporation. And this might be a golden opportunity for us to have more moneys placed at the disposal of DOE to commercialize those technologies very rapidly, and that's a possibility I think we should pursue.

Thank you very much, and thank you, Mr. Chairman.

Mr. **Fuqua**. Thank you.

I want—I'm sorry Mr. Wolpe is gone, I assume that he did leave. But the—I think there was a statement made about the accountability of the Department. And I might point out that section 118 of the act provide for conflict of interest and financial disclosure and does subject the members of the Board to the Ethics in Government Act, and many other factors relating to that. So they are the same as—as other agencies of the Government, including the Congress, according to that.

Mr. Lewis.

Mr. **Lewis**. Thank you, Mr. Chairman.

Mr. Durbin, what is the status of your project in Illinois now on the anhydrous ammonia?

Mr. **Durbin**. At this point the—the private corporation is gathering investors together. And you can imagine that this debate today, what impact it has on their ability to attract people to the project, they don't know from month to month whether the Synthetic Fuels Corporation will actually be in existence; plus keeping an eye on interest rates, they are concerned about what's happened with the increase in interest rates, what it means to the cost of the project. So it's really—they are continuing their efforts. I think it's a sound project, but it's kind of been caught in the middle of our political debate on Capitol Hill about the future of this Corporation.

Mr. LEWIS. Have they submitted to SFC for any loan guarantees or any assistance?

Mr. DURBIN. They had gone through the preliminary process and they have not submitted—they stopped short in the process while they were gathering more investors. But they have been working with the SFC on this project.

Mr. LEWIS. I see. Has there been any interest demonstrated by SFC as far as——

Mr. DURBIN. Oh, yes. I would say in fairness to the Synthetic Fuels Corporation, and particularly to Mr. Noble, that the Synthetic Fuels Corporation has been very open and responsive in my dealings with them. And although many members of the Board have come under fire, I would have to concede that my relationship with that agency has been very good, and I think the same can be said for this corporation working with them.

The problem is now that they are both corporation, Coal Gasification, Inc., as well as Synthetic Fuels Corporation is in a state of limbo. There's really some question as to whether or not they can be counted on in the months to come to fund any project, this one or any other.

Mr. LEWIS. Thank you.

Mr. FUQUA. Thank you, Mr. Lewis.

Dick, we appreciate your being here and your very excellent statement.

Mr. DURBIN. Thank you.

Mr. FUQUA. Our next witness on behalf of the Administration, Hon. Danny J. Boggs, Deputy Secretary of Energy. Mr. Boggs, we are pleased to have you appear this morning and be delighted to hear any statement you wish to make. I notice you have a prepared statement. If you wish it inserted in the record and wish to summarize, that would perfectly be—that would be appreciated.

STATEMENT OF HON. DANNY J. BOGGS, DEPUTY SECRETARY, U.S. DEPARTMENT OF ENERGY

Mr. BOGGS. Thank you, Mr. Chairman, I would appreciate that, if my full statement would be submitted for the record, and I would like to——

Mr. FUQUA. Without objection, it will be.

Mr. BOGGS [continuing]. Take a few minutes to summarize the major points.

Mr. Chairman and members of the committee: I am pleased to represent the Department of Energy and the administration in appearing before you to discuss our recent proposals concerning the Nation's Synthetic Fuels Program.

Our synthetic fuel policy should be set in the context of a national energy policy. We have a goal of an adequate supply of energy at a reasonable cost. We do not precisely define "adequate" in terms of a specific quantity, but we do know that it means a supply sufficient to meet our short- and our long-range needs, and sufficient to assure the Nation of energy nondependence.

We also seek a balanced and mixed energy resource base ranging from essential conventional sources to renewables, and with a new emphasis on energy efficiency as a resource. Achieving a balanced and mixed resource base is critical to achieving energy nondependence.

In considering a strategy on synthetic fuels, it is also important to dispel several common but erroneous assumptions:

A synfuels industry by itself will not prevent the kind of shortages and gasoline lines we experienced in 1973 and again in 1979, because those were due to Government misallocation of available supplies.

We also should note that we can do signficant damage to our economy by creating a massive industry which cannot compete without subsidy. At a time when we are sensitive to competition from abroad, we must be wary of diverting labor and management talent from profitable tax-paying industries and directing it toward industries which require subsidies.

Finally, it's in the interest of the Nation to produce our lowest cost energy first. We believe that there remain many opportunities to produce or conserve energy at costs lower than most synthetic fuels.

But we do believe that as part of our strategy of supporting a balanced and mixed energy resource system, we should have a base of some synthetic fuels experience. Then if future market conditions warrant, the U.S. industry can deploy synthetic fuels plants in an orderly, timely, and rational manner. Thus, the United States does need synthetic fuels capability. But in satisfying this need, we must weigh the need against the costs incurred.

Understanding these considerations in formulating an administration policy, the President was faced with two realities. The first was significantly changed circumstances in the costs, amounts, mix, vulnerability, and import levels of our energy situation with respect to what the market situation was.

The second reality was the inability of the Synthetic Fuels Corporation, as currently set up, to operate without a congressional consensus that would be adequate to permit the confirmation of additional nominees to the Board of Directors.

Looking first at the changed circumstances: in 1980, when the Corporation was founded, it seemed clear—and in fact was the official projection of many sources, including the Government—that the price of oil would go to $100 a barrel by 1990. It was believed that the Corporation would probably result in little or no actual outlays by the Government because loan guarantees would take care of the technical risk that did occur with many of these projects, but it was believed that only in a few cases might those loans have to be paid off. And price guarantees were seen primarily as protection against a downside risk because there was a reasonable fear that in the context of rising oil prices there might be a desire on the part of foreign producers to undercut synthetic fuels by lowering price.

Finally, there was a perception, not only of vulnerability but of rising vulnerability, and a vulnerability that could not be combatted by other means.

Today, these perceptions, I believe, and the realities, have changed. We find oil and other energy to be considerably less expensive than those projections and supplies in general to be more adequate.

Perhaps more importantly, we find a very large gap between the current price of most synthetic fuels technologies proposed and the current price of their competitive energy sources.

It thus appears that price guarantees will be needed in virtually every case under the existing legislation and that those price guarantees will be quite large and will be required to be converted into actual outlays under virtually every circumstance.

I believe that with that change in circumstance, certainly the debate that would have gone on in 1980 would have been considerably different.

Finally, we have found that our vulnerability has decreased, that we have less imports, that we have less import dependence. We do not now have a policy directed toward a single favored technology. We have found that efficiency gains plus all forms of increased production in conventional sources—oil, gas, and coal, in nuclear and renewables—all of these together are advancing our ability to lessen our vulnerability and our import dependence.

Taking these changes into account and with due consideration of our energy policy, the White House announced on May 14 that the President would seek legislation preserving the best features of the current program while bringing about critically needed policy changes.

On May 25, the President transmitted the Energy Security Reserve Amendments of 1984 to rescind $9 billion of the current $14 billion in unobligated funds available to the SFC.

That amendment would also impose an additional guideline for the use of the remaining $5 billion by requiring that the funds be limited to those projects that produce fuels whose costs will not be significantly above the projected market prices of competing fuels.

As President Reagan stated in that message, and I quote:

> Proceeding down the path set by current law could thus result in the inefficient use of billions of dollars. It would also grossly distort the marketplace for synthetic fuels, possibly creating an industry that would be permanently dependent on government subsidies, not the commercially viable industry envisioned by Congress in 1980.

That's the end of the quote from President Reagan.

We share the concern of many Members of Congress that the size and direction of the current synthetic fuels program may lead to wasteful investment of scarce Federal dollars. But we are also cognizant of the views of those who believe that it is in our Nation's long-term interest to move forward aggressively.

The President's new policy reflects our best effort to reconcile these conflicting concerns.

The President has proposed that we leave in place the existing administrative structure supporting Synthetic Fuels Corporation commercialization and retain intact its basic charter.

For the benefit of those who are strong supporters of the SFC continuing its program, let me observe that the current problem confronting the administration is this: Unless the Senate confirms at least two additional directors, the SFC cannot provide any new funds, for at least four Board members must vote to sustain any funding decision. Yet, critics have stated very strongly that they will delay confirmation of any such appointments until the role of the SFC has been thoroughly reviewed.

We believe that our efforts are aimed at restoring an operational SFC by a proposal which seeks to build majority support in Congress.

Let me emphasize that this Nation's energy problems are not over. Current events in the Persian Gulf, particularly recognizing the integrated nature of the world oil market, reinforced the fact that the international flow of oil remains both significant and vulnerable.

In contrast to 1980, however, today we have a 400-million barrel insurance policy in the form of the strategic petroleum reserve. Not only is the reserve four times larger today than it was in 1980, but due to reductions in oil imports the protection it affords has increased even more.

As a result of these market improvements and emergency preparedness measures, the underlying rationale for the full extent of the current program has become inconsistent with the realities of the marketplace.

At the same time, it is important to note that we do have four synthetic fuel projects already in the startup phase or with firm commitments from the Synthetic Fuels Corporation. Those are the Union Oil shale project, the Great Plains coal gasification, the cool water coal gasification to electricity, and the Dow-Syngas coal project. We also have two private projects: Eastman Kodak and Allis-Chalmers, which are under way.

The administration's proposal leaves sufficient money in the Corporation to allow work toward additional projects where in the Board's discretion, but within a balancing constraint of a market-related test which was not previously in play, additional sound projects can be found.

I would add that the Synthetic Fuels Corporation has negotiated a letter of intent with the Great Plains project's sponsors pledging $790 million in price guarantees for the project. Because this aid supplements existing Government involvement, we believe the SFC could support a finding that the additional aid would not be significantly above market price.

In summary, the President concluded the dismantling of the SFC would unnecessarily delay and disrupt the development of commercial synthetic fuels.

The President has also decided that he will soon announce his intent to nominate a full slate of directors to fill the vacancies on the SFC Board.

It is our belief that, when there is a greater consensus between the Congress and the administration on the future of the SFC, the confirmation process for the prospective nominees will be much less contentious.

At the same time, the administration has proposed that Congress rescind $9 billion of the $19 billion originally made available for synthetic fuels and limit the use of the remaining funds to projects that are expected to produce products at costs not substantially above forecast market price.

We think it would be far preferable for the Congress to act quickly in support of the President's proposed policy change so that the new nominees to the SFC Board of Directors can have the benefit of clear direction from Congress in regard to the $5 billion in budget authority that would remain available after enactment of that legislation.

That concludes my summary, Mr. Chairman, and I would be pleased to answer any questions that you or the other members of the committee might have.

[The prepared statement of Mr. Boggs follows:]

STATEMENT OF

DANNY J. BOGGS
DEPUTY SECRETARY
U.S. DEPARTMENT OF ENERGY

Mr. Chairman and Members of the Committee:

I am pleased to represent the Department of Energy and the Administration in appearing before you today to discuss our recent proposals concerning the nation's synthetic fuels program.

Our discussions on synthetic fuels policy should be set in the context of our National Energy Policy.

Our goal is an adequate supply of energy at a reasonable price. We do not precisely define "adequate" in terms of specific quantity, but we know that an "adequate" supply means a supply sufficient to meet our short and long-range needs, and sufficient to assure this Nation of energy non-dependence.

To realize this goal, our strategies are: 1) to minimize federal control and involvement in energy markets while maintaining public health and safety and environmental quality; and, 2) to promote a balanced and mixed energy resource system.

We seek a balanced and mixed energy resource base ranging from essential conventional sources such as oil, gas, coal and nuclear, to renewables such as hydro-electricity, solar, wind, geothermal, and biofuels, and new emphasis on energy efficiency and conservation as resources. Achieving a balanced and mixed resource base is critical to achieving energy non-dependence.

In considering a strategy on synthetic fuels, it is important to dispel several common but erroneous assumptions:

- A synfuels industry, by itself, will not prevent the kind of shortages and gasoline lines we experienced in 1973/74 and again in 1979. These were due to Government misallocation of available supplies.
- We can do significant damage to our economy by creating a massive industry which cannot compete without subsidy. At a time when we are sensitive to competition from abroad, we must be wary of diverting labor and management talent from profitable, tax-paying industries and directing it toward industries which require subsidies, increase the deficit, and create pressure for increased interest rates.
- Finally, it is in the interest of the Nation to produce the lowest cost energy first. There are still many opportunities to produce or conserve energy at costs lower than most synfuels but in many cases--sucn as natural gas--these are being discouraged by counterproductive regulations.

As part of our strategy of supporting a balanced and mixed energy resource system, we should have a base of some synthetic fuels experience. Then, if future market conditions warrant, U.S. industry can deploy the necessary synthetic fuels plants in an orderly, timely and rational manner. Thus, the U.S. does need synthetic fuels capability.

Effective deployment capability is not production capacity in place. Neither is it an arbitrary production goal of a certain quantity of synthetic fuel at some future date.

Rather, it is an information base of verified data that is worth the cost involved. The information is not only technical and financial but also includes knowledge that guides policy and regulation in such areas as environment, land and water management, licensing, and socio-economic development. These baselines are specific to a synfuel feedstock/technology combination. The better the information base, the better the future decisions will be by government and industry.

The Department of Energy contributes to this information base through a program oriented primarily toward the basic and applied research aspects of synfuels development. Probing the fundamental properties of synthetic fuel conversion -- thermodynamics, kinetics, and chemical mechanisms -- can provide new insights which, in turn, can open up new avenues of research and increase the potential for important breakthroughs. Another aspect of the Department's program involves research to improve the environmental, health and safety understanding of synthetic fuel processing and use. This R&D program, while in the national interest, would attract little or no industrial funding without government involvement due to the uncertain nature of potential paybacks. We expect to continue with a productive and creative research program along these lines in the years ahead.

With SFC support, a very limited number of diverse first-of-a-kind, commercial synthetic fuels plants operating in this country will provide the technical basis for an orderly, economic transition toward larger-scale synfuel production capacity if and when future market conditions dictate. Such pioneer facilities would also give decision-makers, not only from the financial community but from local, state and federal regulatory agencies, the basis to establish appropriate guidelines and regulations. Early experience with commercial scale synthetic fuel facilities will be particularly important to industry, government, financial institutions, regulatory agencies, and others who may ultimately be called upon to decide whether, when, and how best to deploy future synfuel plants.

With due consideration of our National Energy Policy, the White House announced on May 14, 1984, that the President would seek legislation preserving the best features of the current program while bringing about a critically needed policy change. This change was based on the need to ensure that public policy remains in step with changing market realities while preserving a potentially important long-range energy option for this country.

On May 25, 1984, the President transmitted the "Energy Security Reserve Amendments of 1984" legislation to rescind $9.0 billion of the current $14.1 billion in unobligated funds now available to the U.S. Synthetic Fuels Corporation (SFC). It would also impose an additional guideline for the use of the remaining $5.1 billion available to the SFC by requiring that these funds be limited to those projects that produce fuels whose prices will not be significantly above projected market prices of competing fuels. In addition, the Corporation believes it can reuse approximately $1.2 billion originally obligated to the TOSCO project. If this view is correct, the Corporation will have a total of $6.3 billion available. However, the availability of these funds for reuse has been the subject of conflicting opinions of Synthetic Fuels Corporation, the Department of the Treasury and the General Accounting Office and the matter is not finally resolved.

We share the concern of many Members of Congress that the size and direction of the current synthetic fuels program may lead to wasteful investment of scarce Federal dollars and needlessly add to the deficit. But we are also cognizant of the views of those who believe that it is in our nation's long-term interest to move forward aggressively in the development of synthetic fuels.

The President's new policy reflects our best effort to reconcile these conflicting concerns. The President has proposed that we leave in place the existing administrative structure for supporting synthetic fuels commercialization--the Synthetic Fuels Corporation--and retain intact its basic charter as provided in the Energy Security Act of 1980.

For the benefit of those who are and have been solid supporters of SFC continuing a program, let me observe that the current problem confronting them and the Administration is this: unless the Senate confirms at least two additional Directors, the SFC cannot function. At least 4 board members must vote to sustain any decision of the Board. Yet critics of SFC have stated very strongly that they will seek to delay confirmation of any such appointments until the role of SFC has been thoroughly reviewed. We believe that our efforts are aimed at restoring an operational SFC by a proposal which seeks to build majority support in the Congress.

Conditions have changed dramatically since Congress acted by overwhelming margins to create and fund the SFC. We face a much different outlook for energy supply, demand, and prices. We are also much less able to risk huge additions to the Federal deficit. The Administration believes that its plan represents a reasonable middle ground between those who would terminate the entire Synthetic Fuels Corporation program and those who believe that we need an even larger synfuels program.

When the Congress established the Synthetic Fuels Corporation in 1980, virtually unanimous bipartisan agreement existed among legislators, as well as within the Executive Branch and in much of the academic and industrial communities, that energy prices would continue their rapid upward rise. The 10-fold increase in world oil prices that had sent economic shockwaves around the globe during the 1970's made predictions of a $100 per barrel price for oil by 1990 seem plausible.

At such price levels synthetic fuels held promise as an economically competitive alternative to traditional fuel sources. An extremely rapid and ambitious schedule for developing a commercial synthetic fuels industry was established. Proponents of the current law argued that the Federal program would have little or no impact on the deficit. At the time, it was anticipated that the loan and price guarantees would not actually result in claims against the Treasury. Today, the economics of the synthetic fuels plants in comparison with oil prices indicate that virtually all of the existing price guarantees will have to be paid by the government as well as necessitating price guarantees for all additional projects.

Since 1980, however, this nation's current energy situation and its outlook for the foreseeable future have changed dramatically, necessitating in turn a change in the appropriate role and scope for the SFC.

As a result of conservation, improved energy efficiency and increased domestic production, we are less dependent on foreign sources today. U.S. consumption of oil is down 11 percent compared to 1980 levels. Consequently, our net oil imports are down 33 percent.

Residential and commercial buildings in the U.S. today consume 20 percent less energy per square foot than they did 10 years ago. Energy consumption per capita has declined by 13 percent since 1973. Energy input per unit of industrial output has declined by 23 percent. Similar improvements have been made in almost every sector of society.

A second major factor has been the current excess of oil production capacity at today's price -- the result of worldwide conservation measures, increased exploration, diversification of energy sources, and, in part, because of the global recession of 1981-82. Not only has the price of world oil been trimmed from $34 per barrel to approximately $29 per barrel, but oil exporting countries have been forced to cut back production to prevent a possible further contraction in oil prices.

Let me emphasize that this nation's energy problems are not over. Current events in the Persian Gulf, particularly recognizing the integrated nature of the world oil market, reinforce the fact that the international flow of oil remains both significant and vulnerable.

In contrast to 1980, however, the nation today has a 400 million barrel "insurance policy" against oil supply disruptions in the form of the Strategic Petroleum Reserve. Not only is the Reserve four times larger today than it was in 1980, but due to reductions in oil imports, it offers the U.S. more than seven times the protection against an interruption in all imported oil supplies than it did four years ago.

As a result of these market improvements and emergency preparedness measures, the underlying rationale for the current program for the widespread commercialization of synthetic fuel projects is inconsistent with the realities of the market place.

Today's market situation clearly indicates that fewer plants will be built than were envisioned by the 1980 legislation. A large number of private synthetic fuel ventures have been deferred or cancelled within the last two to three years. The reasons are: the significant improvement in the supply/demand picture for conventional oil; the decline in the price of oil; and the continued escalation of current and estimated future costs of synthetic fuel plants. In addition, the amount of Federal support required per plant is much greater than anticipated, leading to fewer plants that can receive support from the original appropriation.

We cannot discount the possibility that in the long-run, synthetic fuels may make sense both economically and from an energy security perspective. Current projections do not point to energy shortages and large price increases in the relatively near future. In the long term, particularly as we move into the next century, our goal to foster an adequate supply of energy at reasonable costs, as well as our national economic and security interests, may lead to a situation where synthetic fuels are substituted increasingly for conventional fuels.

At that time, market forces will continue to determine the pace of expansion within the synfuels industry. However, if market forces are to operate in a timely and rational manner and with the best available information -- technical, environmental, regulatory and financial -- a limited number of "first-of-a-kind" plants are desirable today. Furthermore, if the market-driven pace of synthetic fuels expansion accelerates faster than currently forecasted, the existence of such information will make the expansion more efficient.

In formulating its recommendation, the Administration has recognized that the only way for these pioneering facilities to provide the necessary information at sufficient engineering scales would be for the government to continue to assume a portion of the risks.

Currently, four major synthetic fuel projects have received federal support and are proceeding at various stages of design and/or construction:

- The Great Plains Coal Gasification Project -- construction of which is now more than 97 percent complete -- maximum $2.02 billion Loan Guarantee;
- Union Shale Oil Project -- now in startup -- maximum $400 million price guarantee with purchase commitment;
- Cool Water Gasification/Combined Cycle -- now in startup -- maximum $120 million price guarantee;
- Dow Syngas Coal Gasification Plant -- now in design -- maximum $620 million in price guarantees.

Two major coal conversion projects have been constructed and are currently being operated solely without any Federal financing:

- Tennessee Eastman Coal Gasification-to-Chemicals complex now operating near Kingsport, Tennessee;

- Allis-Chalmers Coal Gasification Commercial Module Demonstration Plant now in startup at East Alton, Illinois.

In addition, it is our judgment that the Great Plains Coal Gasification Plant meets the new market price test in the proposed legislation. The Synthetic Fuels Corporation has negotiated a letter of intent with the Great Plains sponsors pledging $790 million in price guarantees for the product. Because this aid supplements an existing government involvement, we believe that the SFC could support a finding that the additional aid is not significantly above the market price. It is our hope and expectation that the Corporation will complete the price support agreement for this project. The project is in final start up activity and offers significant potential information benefits for the Nation's energy security.

These projects will provide this nation with valuable information and experience available only from commercial scale operating facilities. The Administration's view is that the funds we proposed to retain in the SFC should be used to augment those ventures that meet the market price test to achieve a wider diversity of technological options and resources.

In summary, the Administration concluded that dismantling the Synthetic Fuels Corporation would unnecessarily delay and disrupt the development of commercial synthetic fuels.

The President has also decided that he will soon announce his intent to nominate a full slate of directors to fill the vacancies on the SFC board. It is our belief that when there is a greater consensus between the Congress and the Administration on the future of the SFC, the confirmation process for the prospective nominees will be less contentious.

At the same time, however, the Administration is proposing that the Congress rescind $9.0 billion of the $19 billion originally made available for synthetic fuels and limit the use of the remaining funds to projects that are expected to produce products at prices not substantially above forecast market prices.

We think it would be far preferable for the Congress to act quickly in support of the President's proposed policy change so that the new nominees to the SFC Board of Directors can have the benefit of clear direction from Congress in regard to the $5 billion in budget authority that would remain available after enactment of the rescission legislation.

This concludes my statement, Mr. Chairman. I would be pleased to answer any questions you or members of the Committee may have.

Mr. FUQUA. Thank you very much, Mr. Boggs.

On page 2 of your statement, it brings a little concern to me, the first part of that 1973–74 embargo, was due to miscal—misallocation of available supplies.

I remember back there we didn't have have one at that time. That's why we implemented one at the insistence of President Nixon at that time, because—and I recall very vividly that it—I was spending about half of my time and my office about half of their time trying to find some fuel for schoolbuses, for ambulances, emergency vehicles, for farmers that had their combines in the field and could not get—and their crop was spoiling. And in one case, an entire police department was shut down because they couldn't get any fuel and that's why we did have an allocation program so that those who had a requirement for it, or priority, would be—have an availability. But that's neither here nor there with the synfuels corporation. And I don't think it was government policy at that, either, that caused the price to go from about $4 or $5 a barrel to about $30 a barrel, plus, during that period of time.

But the—in the proposal that you are speaking to, the—how did the administration arrive at the $9 billion figure out of about $14.1 that's still available? How was that figure arrived at?

Mr. BOGGS. Well, Mr. Chairman, I think essentially you would have to say that it's a budgetary decision in the sense that you always have to weigh costs against benefits, potential costs against potential benefits, and try to strike some type of balance.

The judgment was that the prospect of expending, not only in the form of guarantees but in ultimate outlays, the entire balance remaining in the Synthetic Fuels Corporation would be excessive. At the same time, we knew that there were projects that at least deserved to be judged on a new market-related basis, so we thought that enough money should be left that there would be some significant funds.

As it turns out, the amount that was rescinded was essentially half of the original amount that had been allocated, had been appropriated, and about half of that amount has been set aside in one means or another under binding commitments. And so the $5 billion that would remain was judged on that kind of a balancing basis to be adequate to allow a new Board under the new test, as we had proposed, to be able to judge some additional projects and see if they would meet that test.

Mr. FUQUA. Let me see if I understand you correctly now. The—was there any significance to the, I guess it would be about $5 million that was remaining—was that the—the—that's—will still be remain under the administration proposal. Was there any significance to that figure if there's not any real significance to the 9 other than it is somewhere between—halfway between the 19 billion?

Mr. BOGGS. Well, as I say, it was judged that that would be an adequate amount to allow the Corporation to determine what projects might be able to meet the market-related test. It was not on the one hand, it was not perceived that all of that $5 billion would necessarily be allocated; but on the other hand, it was not understood that none of it would be. That's a decision that would be left to the Board's discretion under the test as we set it up. Obviously, as it proceeds through Congress, that test might or might not be altered.

But, basically we believe that $5 billion in additional funding was likely to be adequate to cover the type of projects that would meet a market-related test.

Mr. FUQUA. Well, speaking of the market price test that you propose, and in your statement you talk about it, and you say that it's our judgment that the Great Plains coal gasification plant meets a new market price test in the proposed legislation.

How do you base—what kind of judgment do you base that on?

Mr. BOGGS. Well, as I indicated, that would ultimately be a judgment of the Board of Directors. But we did want to make it clear that in formulating the legislative language we did concentrate on the fact that an additional corporation decision would be a decision on additional aid. That is, the Corporation currently has the $2 billion loan guarantee, which is a government, in effect, a government liability in any instance, if the corporation—if the companies that are doing that project were to abandon it. The letter of intent, to the extent that we had examined it, seemed to be very tightly detailed and tightly drawn to be reducing the government's potential liability—that that was not just pure additional aid, but was additional aid tied in to reducing the Government's liabilities.

So we felt that we ought to make the point that in judging any SFC action on Great Plains, it should be judged from the point of view of the cost effectiveness and the market relatedness of the additional aid that they might offer; as, for example, under the proposed letter of intent.

Mr. FUQUA. Well, wouldn't that—that be the role of the SFC, to decide what that criteria means?

Mr. BOGGS. In the end, yes, it's the Board of Directors decision, and that's why I think the testimony is directed towards saying that we think that that would be the case, we think it could meet the market test. It would obviously depend on the specific proposal worked out, they have worked out a letter of intent. Whether that would be the ultimate contract to be drawn between the two would be a decision that would rest in the discretion of the Board.

Mr. FUQUA. Well, what about other projects that are authorized and—and have letters of intent, or, or authorized a letter, or have letters of intent from SFC; what's their status?

Mr. BOGGS. Well, their status would be that—as with other companies that in the past have had letters of intent that they have not been able to finalize.

Mr. FUQUA. Uh-huh.

Mr. BOGGS. They would have the opportunity to attempt to finalize them under the legislation existing at that time. We've made no specific judgment in preparing the legislation that any one or another of the projects might be able to, nor not be able to, meet the criteria as the Board of Directors would determine them, if our legislation or similar types of legislation was passed.

Mr. FUQUA. In the Energy Security Act, the criteria is the security of energy sources, and you are changing that under your proposed language for market pricing as the overriding criteria. Is that correct?

Mr. BOGGS. Well, first, market-related prices would be the term I would use because there is leeway provided by the phrase "not significantly more."

Second, I don't think that you can say that any one criteria is absolutely overriding in all of these types of legislation. The Corporation, as it has found itself so far, has had to weigh competing absolute mandates. It has a production goal and it has a diversity goal, and it has to try to weigh them together. In proposing the legislation we tried to insert a market-related test, which heretofore the Corporation has had in effect no responsibility to try to meet as something additional that must be weighed in with the others. And as has turned out, the production goal, though also mandated in the act, simply cannot be met even under current circumstances. So we don't see it as—as making a goal that is a standard that is any more absolute than the others, but the Corporation has to—would have to meet it if the legislation were enacted, just as with its other mandates.

Mr. FUQUA. Well, what happens if—if the legislation or the nomination process drags on, are there any plans or suggested action that would affect the—particularly impact the Great Plains project?

Mr. BOGGS. Well, as we indicated, we believe that simply sending up nominees, even if we had all the steps prepared—and having been a nominee myself and knowing how long it took from the previous predecessor's departure to my incumbency, it's not as though the administration has been dragging its feet in any significant way.

But we believe that those nominees and those nominations and that confirmation would not really be fair either to the nominees or the administration's policy without at least a significant effort to get a judgment of the Congress, to get a consensus, on where our future synthetic fuel policy would or should be going.

I think, from a practical point of view, any project could not count on funds coming to it in very short order were the administration to take no action. So we believe that we should have a significant and good faith effort to enact our legislation, or some legislation patterned off of it, or even completely different from it, if that's what it turns out to be, so that we know what the congressional consensus and judgment is, so that nominees could then go forward in good order and to implement that congressional direction.

Mr. FUQUA. Well, I think the—I read this morning in the paper that we have 40 days left of this session of Congress. Suppose Congress does not take any action on the rescission that you have proposed?

Mr. BOGGS. Well, I couldn't make any——

Mr. FUQUA. What happens then?

Mr. BOGGS. I couldn't make any judgment on what the President's decision would be at that point. We plan to work actively with Congress during all the days that we have, and at that point the situation would be before him, as it always is.

Mr. FUQUA. You mention in your—on your statement about the SFC believes it can reuse about 1.2 billion originally obligated to the Tosco oil shale project and that—but that conflicting opinions exist on the ability to do so, you mentioned GAO and several others. How do you plan to resolve those differences of opinion?

Mr. BOGGS. Well, in its essence, that's not a DOE decision, it's a decision between SFC and those agencies that are overseeing and dealing with it. I simply thought it was appropriate to have in the testimony——

Mr. FUQUA. Would the Board of Directors have to take action on this?

Mr. BOGGS. Certainly, if they wish to try to use it, they would have to, yes. And then they would be subject to whatever strictures are contained in the varying of—those varying agencies.

Mr. FUQUA. So, they would—they are prohibited from doing so now because there's not a quorum?

Mr. BOGGS. Oh, certainly, the same as with all the rest of the money they have.

Mr. FUQUA. Mrs. Schneider.

Mrs. SCHNEIDER. Well, considering the very thoroughness of your testimony and the questions that the chairman asked, you have eliminated many of my more indepth questions, but let me begin with a couple of simple questions for you which will help me in future reading of the administration's and DOE's proposals or recommendations on energy.

I wonder if you could please define for me energy security, and what you mean when you say energy security, and then differentiate that with energy independence, if there is a differentiation?

Mr. BOGGS. Well, I'm not sure that would qualify as a simple question but I will take a crack at it.

The Secretary, in his discussions, I think has tried to distinguish energy nondependence from energy independence. Energy independence usually means the United States simply doesn't import a single unit of energy, a drop of oil, or a cubic foot of gas. And we don't believe that that really is necessary to achieve a situation where the United States is not significantly vulnerable so that the national economy would be massively disrupted by changes in foreign energy availability.

We don't——

Mrs. SCHNEIDER. Well,——

Mr. BOGGS. We don't believe that we've reached that situation, but we believe that we have had made significant progress. Basically we thought that it could be approached by more production, by more efficiency, and by stockpiling through the strategic petroleum reserve, and we've made advances in all three of those areas. Just as with safety, let's say, whether in a public or in an environmental sense, there are always greater or lesser degrees of it. Security, we believe, is something that is not a single point, it's a continuum.

We believe we have greater energy security today than we did 4 years ago, but we believe that we need to make continued efforts. That's why we are continuing to fill the strategic petroleum reserve; that's why we are continuing to make efforts in areas like natural gas decontrol; and that's why we're continuing our basic request in applied research and development programs.

Mrs. SCHNEIDER. What's our current energy import deficit?

Mr. BOGGS. I believe that, if you measure net imports as a percentage of total American energy consumption, the last couple of years it's been running in the 10- to 12-percent range, whereas, in 1977–78, it was in the 20- to 23-percent range.

Mrs. **Schneider**. Then how does that translate into dollars?

Mr. **Boggs**. I don't have it at my fingertips but I believe that our energy trade deficit was on the order of $40 to $50 billion last year, down from perhaps $70 to $80 billion 3 years earlier, and that that was a lower number in real dollars than 8 years earlier. I could supply those figures for the record.

Mrs. **Schneider**. That would be appreciated, thank you.

[The information follows:]

In 1977, the United States' net energy import deficit was over 18 quadrillion BTU, or almost 24% of all energy consumed in that year. By 1983, our net energy import deficit was only about 8 quadrillion BTU or under 12% of all energy consumption. The value of our energy trade deficit was about $48.5 billion last year. This is significantly lower (in real 1983 dollars) than the comparable number of $66 billion in 1977 and $90 billion in 1980.

The values for the energy import deficit and for the energy trade deficit for the years 1977 through 1983 are:

NET IMPORTS OF ENERGY

[Quadrillion Btu]

Year	Coal	Petroleum	Natural gas	Electricity	Total
1977	(1.38)	18.24	0.98	0.18	18.02
1978	(.87)	17.06	.94	.20	17.33
1979	(1.63)	16.93	1.24	.21	16.75
1980	(2.43)	13.50	.96	.22	12.25
1981	(2.95)	11.38	.86	.35	9.64
1982	(2.80)	9.05	.90	.32	7.47
1983	(2.04)	8.94	.91	.35	8.16

Source: Energy Information Administration, Monthly Energy Review, February 1984.

NET IMPORTS AS A PERCENTAGE OF TOTAL ENERGY CONSUMPTION

[Quadrillion Btu]

Year	Total energy consumption	Net imports	Percent
1977	76.22	18.02	23.6
1978	78.04	77.33	22.2
1979	78.85	16.75	21.2
1980	75.90	12.25	16.1
1981	73.94	9.64	13.0
1982	70.82	7.47	10.5
1983	70.57	8.16	11.6

Source: Energy Information Administration, Monthly Energy Review, February 1984.

ENERGY TRADE DEFICIT

[Millions of dollars]

Year	Energy trade deficit	
	Nominal dollars	1983 dollars
1977	43.0	66.2
1978	40.9	58.6
1979	57.4	75.8
1980	74.9	90.6
1981	71.1	78.6

ENERGY TRADE DEFICIT—Continued

[Millions of dollars]

Year	Energy trade deficit	
	Nominal dollars	1983 dollars
1982	52.7	54.9
1983	48.5	48.5

Source: Energy Information Administration, Monthly Energy Review, February 1984.

Mrs. SCHNEIDER. I was wondering, given the administration's view on the economic viability of synfuels, is it the administration's policy right now to have a greater emphasis or reliance on R&D as opposed to a crash commercialization program?

Mr. BOGGS. Well, I think that it's to move the Government's efforts toward the areas which are less commercially related in terms of basic research and development where Government dollars both can go a lot further and where private efforts are less likely to be economically motivated because of basic research. That definitely has been our policy and has been stated across the board in our testimonies on our budget over the last several years.

Mrs. SCHNEIDER. Is there any private sector entity that is currently pursuing the development of synthetic fuels without any Federal support?

Mr. BOGGS. Well, as I indicated in the testimony, there are at least two significant synthetic fuels projects—Eastman Kodak and Allis-Chalmers—that are in production with private funding. There is certainly a wide range of activities related to synthetic fuels.

Mrs. SCHNEIDER. But Eastman is not specifically synthetic fuels itself?

Mr. BOGGS. Well, it makes——

Mrs. SCHNEIDER. It's—it's——

Mr. BOGGS [continuing]. It makes coal into chemical products.

Mrs. SCHNEIDER. Yes.

Mr. BOGGS. If it were—if it were to—it's my understanding, at least, I could be corrected—but it's my understanding that if it were to apply for an SFC grant, it would probably meet the basic criteria of being a synthetic fuel project.

Mrs. SCHNEIDER. OK.

My final question is: We have spent as taxpayers, I guess, about $1.2 billion on the TOSCO project, and certainly this administration, unlike previous administrations, has made great strides in collecting moneys that are due to us, such as the student loans, and loans that have been made to the Small Business Administration, and other types of subsidies and loan guarantees that have been expended. We've made, you know, significant moves toward recapturing some of that money. TOSCO—is that all lost?

Mr. BOGGS. It's my understanding that nothing——

Mr. FUQUA. No money was lost—no money was spent.

Mr. BOGGS. My understanding—and we could provide the details for the record—is that certainly that the vast bulk, if not 100 percent—it was my previous understanding that it was 100 percent—was repaid as a result of an agreement between TOSCO and Exxon, where in effect we were able to call in a guarantee. And that in an outlay sense there was no loss. There's a bookkeeping debit against the Corporation's ability to draw money of $1.2 billion. That's what's under dispute, as to whether that bookkeeping entry can be——

Mrs. **Schneider**. I see.

Mr. **Boggs** [continuing]. Used. But it is not a case where the Government wrote checks to anybody.

Mrs. **Schneider**. I see, OK.

Mr. **Boggs**. I could provide further details for the record as to how that transaction is done if you would like.

Mr. **Fuqua**. I think—I think it would be helpful to do that in case there is an impression that——

Mr. **Boggs**. Yes.

Mr. **Fuqua** [continuing]. The money was actually spent.

[The information follows:]

On November 10, 1981, DOE and TOSCO completed a loan guarantee agreement for $1,233 million. At the time the Federal Financing Bank (FFB), the financial institution granting the loan, established a line of credit for TOSCO's use. Between November, 1981, and April, 1982, TOSCO drew upon that line of credit for $75.5 million. When Exxon Corporation bought TOSCO's share of the Colony project, one of the conditions of sale was that TOSCO's share be free and clear of encumbrances including the government lien. In June 1982, TOSCO repaid, including $2.1 million interest, $77.6 million to theFFB where it was credited to general revenues rather than the Energy Security Reserve.

When the loan guarantee agreement was completed, TOSCO paid DOE a $1.425 million fee for the guarantee. Responsibility for the project was transferred to the SFC on February 10, 1982, and the SFC returned $900,000 of this fee to TOSCO when the loan was terminated on June 22, 1982. This repayment was due to the fact that the guarantee had only been in effect for a few months while the fee was for a full year.

The Energy Security Reserve account was reduced by the nearly $78 million line of credit used and repaid by TOSCO. In addition, the $1,155 million remaining line of credit at the FFB was also removed from the Energy Security Reserve account but the reuse of these funds is a subject of conflicting legal opinion requiring further resolution. The U.S. Treasury received a net fee of about one-half million dollars for execution of the loan guarantee. Thus, TOSCO's project actually resulted in net revenues to the Treasury.

Mrs. **Schneider**. That was certainly my impression. Thank you. Thank you very much for your insightful testimony.

Mr. **Fuqua**. Thank you. Mr. Durbin.

Mr. **Durbin**. Thank you, Mr. Chairman.

Mr. Boggs, you—in your statement you indicate that the United States does need a synthetic fuels capability. I certainly would concur with that remark. But is it your judgment that in the projects that have been approved, the ones we have discussed today: those through DOE on an interim basis, those directly by Synfuels, and those which received a letter of intent from the Synthetic Fuels Corporation earlier this year—is it your judgment that with those projects we have met our synthetic fuels need in this Nation?

Mr. **Boggs**. Well, we believe that those are certainly steps toward that capability. One of the reasons that we did not take the decision—excuse me—to—to try to abolish the Corporation and leave no money in it, was that we knew that there were other technologies that were at least candidates. The technologies that did move out the most rapidly, the coal gasification and oil shale, I think are two very significant areas of capability that have certainly shown technically they can get into production.

But the reason that we did leave some significant additional money was to leave the field open for other types of capability—there's certainly a broad array of technologies that come under the name of the synthetic fuels and they are not all at the same stage of development. That's something that the Corporation has to look at.

Mr. **Durbin**. So the administration does see the potential for other synthetic fuels capabilities coming forward that we are not aware of today. In your testimony you've left the door open at Synfuels so that it can handle that—that potentiality of that possible?

Mr. **Boggs**. We've left the door open. You used the phrase "that we're not aware of today." I think probably there are not many technical technologies that we're not aware of that are likely to show up in the next couple of years. But there may be uses of those technologies—combinations of investors, and resource bases, that might pull it together, that have not come forward as of yet. That's one reason we did want to leave some money available.

Mr. **Durbin**. Well, let's talk about how much you did leave available. Let's assume for our discussion here for a moment that Synthetic Fuels Corporation goes ahead and funds all the projects that have received a letter of intent this spring. Do you have any idea if the administration is successful in cutting back the amount of money that Synfuels can give in loan guarantees and the like, do you have any idea how much money will then be left over for all these other potential technologies?

Mr. **Boggs**. Well, I believe that the $5.1 billion is not adequate for the full extent of the letters of intent that have already been issued. As I indicated, we have not made the judgment as to which of those would be able to meet the market-related tests or as to what the board of directors' judgment would be in terms of those projects, either at their current scale or as rescaled versus other competitors.

If the question is, can SFC fund all of its letters of intent exactly as now issued with the remaining available funds, the answer is no.

Mr. **Durbin**. How are you leaving the door open, then? You've closed the door. When you reduce the amount of money that SFC has available for these technologies to the point where they cannot even fund the existing projects with letters of intent, I don't believe the administration has even left a crack in the door. What you have done is reduce it to the point where there is no future for this agency. You just won't come forward and turn out the lights, I am afraid, because the political side of it is too hard to handle.

Mr. **Boggs**. Well, Congressman, I think that would only be accurate if you assumed that all of those existing letters of intent would meet the market-related test, and that all we were trying to do was in some way to cut the money for those existing letters of intent. That was not our intention. Certainly had we not desired to place a market-related test in it as well, we would have felt some responsibility to bring those numbers into balance.

If, however, some or all of those existing projects drop out either, as I say, by failing the test or by being rescaled, then there's room for other projects.

Mr. **Durbin**. I would just suggest that there is a conflict between your statement about the commitment of this administration to a synthetic fuels capability and the fact that you're suggesting a funding level which gives this agency little or nothing to work with in the future. What you have done is, I think, diminished their capability of—of meeting that stated national goal. I don't believe that comes anywhere close to what you call a reasonable middle ground to what faces us.

I think in fact you are—you are turning down this agency's power and function to the point where they won't be able to look for these new technologies and they won't be able to fund new projects in the future.

Mr. **Boggs**. I appreciate your comments. We do have a difference of opinion on that.

Mr. **Durbin**. It appears we do.

Mr. **Boggs**. I would make the point that to judge the level of commitment solely on the basis of whether it is as large as the number that was put in place 4 years ago, without looking at the fact that we would be talking about a total available money, including already expended moneys, already committed moneys, of $10 billion, and recognizing that $10 billion is essentially the total cost of our entire strategic petroleum reserve to date, I find it a little difficult to say that that is a modest commitment.

[The information follows:]

STRATEGIC PETROLEUM RESERVE OUTLAYS

[In thousands of dollars]

	Oil	Facilities
Through fiscal year 1978	$746,078	$330,591
Fiscal year 1979	542,363	460,474
Fiscal year 1980	20,507	305,036
Fiscal year 1981	3,551,310	249,133
Fiscal year 1982	3,686,654	169,031
Fiscal year 1983	1,640,635	195,117
Fiscal year 1984 thrrough Apr. 30, 1984	1,208,781	96,382
Total	11,396,328	1,805,764

The other costs associated with the SPR since it was authorized in 1975 total $103.2 million. The total cost of the program through April 1984 is $13.332 billion.

Mr. **Durbin**. I would like to ask you another question related to the appointees. It appears that we are now at a stand-off here between those who say on one hand we won't approve any appointees—and I assume you're talking about the Senate with its power of confirmation—we won't approve any new appointees to the SFC Board until we know what the future function of the SFC will be. And those that say on the other hand, we really don't know what the future's going to be of SFC until we see the kind of people you are going to appoint.

This kind of stand-off could go on for quite a while when you consider the limited number of time—limited amount of time that Congress left in session this year.

What kind of hope can you offer to us that there's going to be some sort of break here? Would the administration at least come forward with two or three blue ribbon names of people that that they would appoint to SFC as a showing that you want this agency to continue?

Mr. BOGGS. Well, it is our intention, and the statement in the testimony that we would at a relatively near time do what is in fact frequently done with nominees, to announce the intent to nominate, put out the names that would go forward for the Board.

I must say that in terms of the fundamental issues surrounding the Synthetic Fuels Corporation, I really don't believe that the names of the individual Board members, or the performance of existing Board members, are really the fundamental issues about what the cost and the prospects of synthetic fuel will be.

I don't believe that any other set of existing nominees or future nominees would be able to come up with synthetic fuel projects that would meet the basic objections of costs and likely future need for subsidies.

So, as I indicated, we will be putting forward those names with an announcement of intent to nominate, but I believe that it's a little fallacious to say that that is really the key issue as far as the future of the Corporation and the future of synthetic fuels.

Mr. DURBIN. I think it is an important concern, though.

Mr. BOGGS. Yes.

Mr. DURBIN. The people who were appointed actually believe in the mission of the agency.

Mr. BOGGS. Well, I think as you will hear by the people who testify following me, there's little doubt that those who have been in charge of it believe very strongly in its mission.

Mr. DURBIN. Can you give us any kind of a clue as to when we might hear these intent to nominate suggestions?

Mr. BOGGS. I could not give you a date. As I indicated, I believe it is in the kind of normal processing. I can, again, only refer to my own experience where the difference between the time when I thought I knew it was going to happen and the time it happened was quite an extensive period itself. But I'm not being coy about it. It's simply that we do intend to have those names announced as soon as the type of processes that you need to go through are done.

Mr. DURBIN. Thanks, Mr. Boggs. Thank you, Mr. Chairman.

Mr. FUQUA. Thank you. Mr. Lewis.

Mr. LEWIS. Thank you, Mr. Chairman.

Mr. Boggs, are the nominees going to be submitted whether or not the rescission legislation passes?

Mr. BOGGS. Well, it's certainly not conditional on the passage of the President's legislation. It's not a threat that you pass our legislation or it will not be done. Certainly, if a failure to come to some agreement were to continue over such an extended period of time, names would ultimately be submitted, I believe. But I think that under current circumstances where we have a Congress to work with, and under the circumstances where you would have to be wary—certainly—as I said, it would be a decision for the President—but I think there would be a lot of discussion about holding nominees strictly until they could get an appointment where they didn't have to be facing confirmation.

I believe that what we've said in good faith is that we want to reach a consensus with the Congress on what kind of synthetic fuel direction we want to have, and that it's appropriate to have your nominees go up in an atmosphere where they can have that kind of backing.

Mr. LEWIS. In your testimony, you point out about legislation preserving the best features of the current program while bringing about critically needed policy change.

Then again in the overall plan, we're talking about leaving in place existing administrative structure for supporting synthetic fuels commercialization, which is SNF, and SFC, and retain intact its basic charter.

I have a problem with SFC, period, but I guess what my concerns are, we have practically no synthetic fuel programs, that I can determine, currently in the United States. We have some but very little. It seems like the majority of our large corporations are waiting for SFC's future to be determined before they decide whether or not they are going to put any of their bucks into making a reasonable attempt at a synthetic fuels. In a period of time when some of these corporations are making some of the greatest profits in the history of the capitalistic system, they are still dragging their heels, in my judgment.

I see that other types of legislation that have been passed in some States, including my own State, which helped to eliminate and reduce some of the problems we have. Now, to get to what I really want to say, do you feel that today we have a synthetic fuel program in progress? And in addition, do you feel that with SFC's continuation we will have a better program in progress, and to what extent?

Mr. BOGGS. Well, I think a couple of points need to be made. One is that in terms of capacity, in terms of actual production, which I think is one thing that people have in mind when they talk about a synthetic fuel program, it's clear that if the Corporation stops tomorrow, if you adopt the administration's program, or if they spend the full $19 billion—under any of those circumstances, we will not have capacity at anything like what was being contemplated, simply the economics of it turned out to be quite different.

In terms of capability, when you say, can we have some assurance that plants of certain kinds can be built in the United States; can be licensed, in effect getting permits, environmental type permits—I think we have a start on that with an oil shale, with a coal gasification project, with the cool water, with the Dow Syngas coming along. I think that the remaining funds, which will be in total as large as those already expended, leaves the opportunity certainly, there for additional projects of that sort, if we can find some kind of reasonable relationship with current costs.

So I think we have made some progress, we do have some knowledge. I think it is rather interesting that the discussion around synfuels in an honest way has turned to economics from really the technology. It started out, you know, that there was a lot of concern that these loan guarantees would be dead losses because the plants, you know, just couldn't be built at cost, they couldn't operate.

I think what we've got in progress is showing that the risk has shifted from the technological risk to the economic risk. And I think that's something that shows an amount of progress that I think we now have a better understanding that we can probably build these things. The question is, how much is it going to cost? How much is it worth to us to have that kind of knowledge?

And we believe there has to be some moderation and balance with our other national needs and national budgets.

Mr. LEWIS. Well, I agree with you to an extent that economic risk is now the big fund—the big factor. But when we take into consideration that we receive, or use, in this country, about 4 to 6 percent of our crude from the Far East and the rest comes from other sources—that we have become complacent in that respect and because of that, we have reduced the need for synfuels from the—for the private sector reinvesting its money into this area; and just because we do have a glut and the availability of additional fuel oil whenever we need it, practically.

Do you share that concern?

Mr. BOGGS. Well, I think we've never used terms like glut or complacency because I don't think that they are justified. At the same time, the question is, what are the best areas into which money should be put? And we believe that's what the private sector is really a pretty good judge of.

We've seen money continuing to go into synthetic fuels development, but we've also seen vast amounts of money go into conservation, into efficiency, into conventional production, into renewables. And all of these have helped contribute to that improvement in the situation.

So I think every time somebody drills a new oil well, opens a new coal mine, adds insulation, or buys an efficient car, they're demonstrating an absence of complacency. And they're taking steps that help us move forward, just as I think the Department is with its basic research program, and just as many companies are by continuing their research and development in these areas.

The fact that they have not moved into commercial operation with areas that are not now commercial, I don't believe, is an indication of complacency.

Mr. LEWIS. I guess we share a difference of opinion as well.

Thank you, Mr. Chairman.

Mr. FUQUA. Thank you, Mr. Lewis. Mr. Boucher.

Mr. BOUCHER. Thank you, Mr. Chairman.

Mr. Boggs, I'm somewhat curious as to the role that DOE played in formulating the administration's rescission recommendations with regard to SFC—the Synthetic Fuels Corporation. And in view of the independent nature of that Corporation, can you enlighten us as to why DOE has a role at all?

Mr. BOGGS. Well, in terms of, you know, who said what to whom, and what room, I think that probably is not an appropriate subject of testimony as to how the President reached his decision, even if I were fully conversant with it, which I'm not. I think the DOE role is clearly that the DOE is a policy arm of the administration. The Synthetic Fuels Corporation, by design and by legislation, is not a policy arm of the administration. The President has no control over the Synthetic Fuels Corporation. So that if the President's policy is to have a spokesman, then someone else has to be chosen, and the Department of Energy is the general energy policy spokesman for the administration. Since we have, obviously, a number of very direct concerns in the research and development area, in the Great Plains area, which we continue to manage as a result of the initial legislation, I think it's not particularly surprising that Secretary Hodel, and the Department in support of him, has been active in this area.

I am here today because we got the invitation and the Secretary was out of town, and we are pleased to present the administration's policy because we support it.

Mr. **BOUCHER**. Well, I certainly don't mean the question to imply any criticism of your participation here. We welcome you very much. Indeed, I hope that your appearance here today signifies the Department of Energy's desire to play somewhat of a greater role in research and development efforts in the field of fossil fuels.

We've heard several witnesses preceding you today testify to the effect that it might be helpful for some of the Synthetic Fuels Corporation's appropriate moneys to be allocated to the Department of Energy for its coal-related research instead.

I happen to be of the view that DOE presents a better promise for a rapid commercialization of some of the less sophisticated technologies such as coal cleaning techniques and coal and water mixtures than does the Synthetic Fuels Corporation.

I would be interested in your comments as to whether DOE would view favorably a larger role in research and development efforts at this time, perhaps sharing in moneys presently appropriated to the Synthetic Fuels Corporation.

Mr. **BOGGS**. Well, first I should indicate that I don't think that this is or should be viewed as any kind of a turf fight with the Department seeking additional authority, because as has earlier been indicated, within the research and development area there is not a conflict as a result of the legislation. The DOE is the agency in that area, and in preparing and submitting our budgets we try to cover what we think is appropriate and can be done within budgetary constraints.

I believe Mr. Vaughan, tomorrow, will be prepared to go into considerable detail as to the different technologies and DOE's role in each of them. And I think that that's really the context in which it should be viewed. Are we doing the right things? Are we doing enough?

Certainly, the Secretary, in formulating his budget and in discussing with people, has had to consider that at each stage of the process. And if there's a demonstrated gap where there's something that we see that is appropriate and not being funded, then I think the Secretary certainly wants to keep that under consideration.

As I say, Mr. Vaughan is the one who's expert on it. I have looked at the testimony which indicates that we do not see a specific gap over the next year or two where we can identify a project that we believe would be appropriate, but we are certainly open to consider that prospect.

I would add that I don't think that we should look at the SFC's appropriation in some way as free money that isn't really taxpayers' dollars or isn't really budgetary money because its already been appropriated and that, therefore, we are free to use a different set of considerations in deciding whether it's a good budgetary expenditure.

We think that in considering our budget, Congress and we together try to make that judgment on what are the projects that we can best participate in and we're happy to continue that dialog and press forward with what the congressional outcome is.

Mr. BOUCHER. What I infer from what your testimony is that DOE would not necessarily resist the effort to have additional funds authorized for your fossil fuel research projects, but that perhaps I should propound that question to Secretary Vaughan?

Mr. BOGGS. Well, I believe you should. I would say that it is generally our effort to resist expenditures that are not contained in the President's budget, and I imagine we will continue that policy. Sometimes we're successful, sometimes we're not.

Mr. BOUCHER. Let me pursue a line of questioning with regard to the Nation's energy security at the moment.

I'm somewhat troubled by the statement that President Reagan sent to the Congress accompanying his proposed rescission of Synthetic Fuels Corporation authority. In that statement he implies that we should be somewhat less concerned about our energy vulnerability than we were several years ago.

I am wondering if you can give me some current information about the threat that is posed to the United States, if the Strait of Hormuz is closed, what is that going to do in terms of decreasing the number of barrels of oil available in the world market? And do you see a source of replacement for that oil should that event occur?

Mr. BOGGS. Well, I would think I would say first that our concern for the prospect of energy vulnerability, I think, is no less. Our recognition that our vulnerability has been lessened, though not removed, as I think Secretary Shultz said yesterday, however, is that we do recognize that that change has occurred.

I would be happy to provide an analysis for the record with more detailed numbers, but speaking in rough terms and remembering that we're speaking I think quite hypothetically about a complete closure of the Strait of Hormuz, because there's a lot of analysis by people far more competent in it than I, that that would be a very difficult task, it would be an unlikely task. The President has indicated in concert with our allies that that would be something that we would not permit to occur.

But in that instance, I believe the numbers would be on the order of 7 or 8 million barrels a day with offsets available from increased production of other countries of, again speaking very roughly, 3 million barrels a day or more; some offset from the Saudi pipeline and other pipelines; an offset available from the U.S. Strategic Petroleum Reserve and other stocks.

Certainly, that event is unlikely, and as I said, the President has indicated it would not occur, it would certainly be a serious event. But we believe that both its likelihood and its seriousness are less than would have been the case, let us say, 3 years ago.

Mr. BOUCHER. Well, I would very much appreciate your submitting a more detailed analysis to the committee. I would like to have the benefit of that.

[The information follows:]

If the Strait of Hormuz were closed, the direct loss of oil to world markets would be 8-9 million barrels per day according to EIA estimates. If there is no unusual buildup in commercial stocks, this disruption could be largely offset for several months by up to 3 million barrels per day of unused production capacity outside the Persian Gulf, up to 1 million barrels per day increase in pipeline shipments from Gulf producers, about 2 million barrels per day from the SPR and about 1 to 2 million barrels per day from the government-owned and private stocks of other consuming nations. Thus, it is possible that, in the best circumstances, there would be no reduction in net world supply, or, perhaps, as little as a 1 million barrel per day reduction in net supply even if the Strait were blocked for several months. Notwithstanding little, if any, net shortfall, prices could rise because of psychological factors induced by market uncertainty and by increased costs due to required changes in supply sources.

As the SPR and other stocks were depleted, the world supply shortfall would increase. However, as such stocks are depleted, the increasing supply shortfall would cause further market price increases and, therefore, demand would decline accordingly.

Mr. BOUCHER. I wonder if, though, you could make some estimate today as to what you believe the effect on the world price of oil over the long term would be in the event that the Strait of Hormuz was closed?

Mr. BOGGS. Well, I could not submit—wouldn't have that analysis, wouldn't have a number for you. I think any of the analyses you used the term long term all of the analyses that I've seen done by any source relate to closures or losses of supply from whatever source, over a specific period of time. The long-term trend really depends on much more fundamental and long range economic factors, the depletion of oil and things of that sort.

Mr. BOUCHER. Let me, if I may, sharpen the question somewhat. What would you anticipate the effect on the world price of oil being; or let's just say the price of oil here in the United States, following the exhaustion of our strategic reserve, which is just for a very limited period?

Mr. BOGGS. Well, the period is not so limited in the sense that our reserve is now equal to 90 days of all imports, equal to 18 months of Arab OPEC imports, even more of Persian Gulf imports—and that's even on a static analysis. So I think it doesn't take much perspicacity to indicate that a complete closure of the Strait of Hormuz would put upward pressure on prices.

As to what the level would be depends on a vast variety of factors. I think we're talking in very hypothetical and very improbable occurrences.

Mr. BOUCHER. Well, I would appreciate very much your submitting in some detail an analysis of those questions. I think that would be helpful to us in evaluating just how serious the continuing threat to our energy security is based upon our dependence on foreign sources.

Thank you very much, Mr. Boggs.

[The information follows:]

With regard to the price impact of closure of the Strait of Hormuz, I draw your attention to the following analysis of the recent EIA report entitled "Annual Energy Outlook, 1983." On page 16 of that report the EIA finds "a supply disruption of about 10 million barrels per day (gross) could increase prices by as little as $10 per barrel or by more than $50 per barrel." The study notes that the size of the price impact depends on the amount of government stock draws, inventory changes and the response of demand to price changes. As indicated in the insert on page 107, this disruption is larger than what would result from a closure of the Strait of Hormuz.

Mr. FUQUA. If the gentleman would yield—one other additional point is the treaty obligations that we have to Europe and Japan to share any shortfall with them. And that also factors in, particularly even though we're only importing, I believe you said, 10 or 12 percent now. But their imports are much higher from the Middle East, and so it would have a dramatic impact on the United States.

Mr. Bateman.

Mr. BATEMAN. Thank you, Mr. Chairman.

Unfortunately, being late to arrive, I am not prepared with as many questions as I think lurk in this subject matter, Secretary Boggs.

Let me ask you, however, if the administration has addressed Mrs. Lloyd's proposed, H.R. 5593? Do you see therein a possible basis for accommodating the conflicts and point of view that I think are swirling around this subject?

Mr. BOGGS. I am not aware of there being an official administration position statement or testimony. I don't believe there have been hearings on that bill as of yet. I think in some of my discussions——

Mr. BATEMAN. Well, we will probably be discussing in more detail those specific features, some of the legislation, in tomorrow's hearing.

Mr. Chairman, that's all the questions that I feel constrained to ask this morning, though, as I say, I think there are many that are swirling around on this subject matter.

Mr. BOGGS. As the chairman indicated, we will have other witnesses available at later hearings that would be able to address that.

Mr. FUQUA. One—one thing that I think we need to clarify, Mr. Boggs, and you may have to provide this for the record, is, there's an impression left that the SFC has spent something like $10 billion. And, really, that is not quite an accurate statement because two or three of that was for the solar bank, some went for biomass, and other matters.

Do you have those figures handy or——

Mr. BOGGS. I could provide it in detail. I have a sketchy sheet that I couldn't run down entirely. But you are exactly right, I was not aware there was an impression they had spent a full $10 billion. But I could give you——

Mr. FUQUA. Really——

Mr. BOGGS. I could provide that.

Mr. FUQUA [continuing]. There's really only $2 or $3 billion that has been committed for synthetic fuel development, as I understand.

Mr. BOGGS. You could probably get that up to perhaps $5 billion when you count the Great Plains loan guarantee and the TOSCO loan issue, as well as the others, but——

Mr. FUQUA. But that would revert back, though——

Mr. **Boggs**. I could provide a detail that would start with the $20 billion which was authorized, and then go through the $19 billion that was appropriated, and take it right on down, take it——

Mr. **Fuqua**. I think it would be helpful if you could provide that.

[The information follows:]

Of the total appropriation of $19 billion for Energy Security Reserve purposes, only about $282 million has actually been expended. An initial $200 million was spent by DOE during first round feasibility study/cooperative agreements activities during 1980. About $82 million has been spent on administration, studies, etc.

The following tables shows the commitment of fund in question:

Previous Commitment of $4.9 billion of Energy Security Reserve [ERS] account

[Millions of dollars]

Initial authorization for ESR purposes	$20,000
Initial appropriation for ESR purposes	$19,000
Obligations and Expenditure:	
Redirected for use in biomass/alcohol fuels programs	1,270
Subsequently rescinded	1,018
DOE loan guarantee set-aside	42
DOE administrative expenses	[1] 3
DOA administrative expenses	[1] 2
DOE remaining appropriation	187
DOA remaining appropriation	18
Rescinded from DOE second round feasibility studies/cooperative agreements	300
DOE first round feasibility studies/cooperative agreements	[1] 200
TOSCO loan-guarantee set-aside (residual)	[2] 1,155
Reduction for line of credit used by TOSCO (repaid to general revenues)	78
Union Oil Shale Project (phase I) price guarantee set-aside	400
Great Plains Coal Gasification Project loan guarantee set-aside	673
Cool Water Gasification/Combined cycle Project price guarantee set-aside	120
Dow Syngas Gasification Project price guarantee set-aside	620
Peat Methanol Associates Project assistance	[1] 1
Administrative expenses:	
Synthetic Fuels Corporation (SFC)I07[1] 58	
Department of Energy	[1] 18
Total Obligations and expenditures	4,893
Remaining SFC appropriation	14,107

[1] Monies actually spent from the U.S. Treasury.

[2] The Corporation may be able to reuse this commitment, subject to resolution of conflicting legal opinions.

Mr. **Boggs**. The chairman is exactly right, nothing—in fact, in terms of actual outlays by the Corporation, there really have been none other than for administrative expenses because the Union project price guarantees won't kick in until they begin to make production, which they are close to but have not. The Great Plains loan guarantees haven't been called in, and so on down the line.

Mr. **Fuqua**. Thank you very much for being here this morning.

Mr. **Boggs**. Thank you, Mr. Chairman.

Mr. **Fuqua**. Our concluding witness today will be Mr. Edward E. Noble, the chairman of the board of the United States Synthetic Fuels Corporation. And I think he is accompanied by Mr. Leonard C. Axelrod, the group vice president for Operations for the Synthetic Fuels Corporation.

Mr. Noble, I apologize for our lengthy hearing today but as you can well determine, there's a great deal of interest associated with the matter of synthetic fuel development.

We are pleased to have you again before our committee, Mr. Noble. And you have a statement with some charts—if you desire, we can make that in its entirety part of the record, if you wish to summarize, whichever would be your choice.

STATEMENT OF EDWARD E. NOBLE, CHAIRMAN, UNITED STATES SYNTHETIC FUELS CORPORATION, ACCOMPANIED BY LEONARD C. AXELROD, GROUP VICE PRESIDENT FOR OPERATIONS; HODSON THORNBER, VICE PRESIDENT, FINANCE; AND JEFFREY LIPKIN, GENERAL COUNSEL

Mr. NOBLE. Thank you, Mr. Chairman. I would like to make my complete statement part of the record and just——

Mr. FUQUA. Without objection.

Mr. NOBLE [continuing]. Summarize very briefly if I could.

Mr. FUQUA. Without objection.

Mr. NOBLE. Mr. Chairman, members of the subcommittee, I am pleased to be here today. I have submitted written testimony and ask that it be included in its entirety in the record of this hearing.

I have listened with interest to most of the testimony and discussion so far this morning, and would like to take just a few minutes now to correct what I believe are some very misleading statements about the Corporation and our program.

As defined in the Corporation's basic business plan, our program is neither a massive nor a wasteful investment of the Federal dollars; rather, it is a highly responsible, but limited program, to commercialize the key technologies for the major domestic synthetic fuel resources.

Our program carefully allocates funds among coal, oil shale, tar sands, and heavy oil; and when implemented, it will provide the country with the data base necessary to make informed decisions about the desired balance between domestic synthetic fuel production and oil imports.

Today, the Corporation is about two-thirds of the way to completing a very sound, successful projects program, which will fully satisfy the diversity and energy security objectives of the Energy Security Act.

We have executed two assistance contracts, authorized letters of intent for eight additional projects, and we have open at this time three solicitations directed to coal projects.

From a business point of view, this program is on target. The projects to which we have awarded assistance are expected to operate competitively for 20 to 30 years after the assistance ends and to pay back to the taxpayers substantial amounts, if not all, of the assistance.

The projects with which we are negotiating are mature in terms of design, and have made a very substantial equity in management commitments.

The open solicitations should elicit projects with a high degree of management sophistication and well advanced design levels.

Today, the irony is that the Corporation is very close to success in business terms. Our major impediment is the lack of an operational board of directors. The other potential impediment would be a reduction in our funding authority so as to—so severe as to force us to eliminate programmatically essential projects.

The ability to produce synthetic fuels commercially from domestic resources will put a cap on world prices—give the United States leverage in dealing with the international community and provide us with flexibility in responding to any regional crisis in the oil exporting areas of the world.

And what is more important, I believe, and most have misunderstood in all of the current controversy, is that the net cost to the Corporation's present—and I am not going to say 7,900 million—but 7,933 million, now that's the amount that we have signed contracts or authorized letters of intent.

We estimate that that will cost approximately $218 million total. That's a very small price, indeed, to pay for long-term energy security and economic stability.

Now, this estimate that I've just quoted, and I'm not taking issue with my friends at DOE, but the Corporation's rather low energy price forecast that gave us a cost of about 218 million against 7,933 million, that put at risk, if we use the same calculations but also use the most recent Department of Energy median energy price projections, and because of the what we call taxpayer recoupments that the SFC has negotiated with these projects—and, incidentally, it's not required of us to negotiate these recoupments, but we have—the taxpayers would have a net profit of roughly $6 billion.

Gentlemen, I think we need to get on with this program. I'm very proud of what our staff has done to this date, and I'll be happy to answer any questions you have.

[The prepared statement of Mr. Noble follows:]

United States Synthetic Fuels Corporation
2121 K Street, N.W. Washington, District of Columbia 20586 Telephone (202) 822-6600

Testimony of Edward E. Noble, Chairman
U.S. Synthetic Fuels Corporation
Before the Subcommittee on Energy Development
and Applications
Committee on Science and Technology
June 6, 1984
Washington, D.C.

Mr. Chairman, Members of the Subcommittee: I am pleased to have this opportunity to discuss with you the status of the U.S. Synthetic Fuels Corporation. The past year has been one of strong challenge but also of solid progress with respect to our projects program. I would like to discuss this first.

The Energy Security Act established the Corporation to provide financial assistance to synthetic fuel projects for the purpose of "demonstrating at the earliest feasible time the practicality of commercial production of synthetic fuel from domestic resources employing the widest diversity of feasible technologies" (Section 100(b)(2)(A)). From the beginning our objective has been to develop commercial operating experience with a variety of technologies for the major synthetic fuel resources. In February 1984 the Board of Directors adopted a basic business plan which specifies the scope and cost of such a program.

The Corporation's basic business plan allocates roughly $5 billion to support coal, $5 billion for shale technologies, and $1 billion for tar sands/heavy oil development. The remaining monies, approximately $3.7 billion, are set aside as reserves and for any additional projects which, in the judgment of the Board, would contribute significantly to the production or diversity goals of the Act.

In the shale area, the Corporation has authorized letters of intent with three projects, for a total obligational commitment of $4.9 billion. Two points should be clearly understood about letters of intent and the Corporation's funding commitments. First, letters of intent are non-binding statements of intent on my part to recommend a financial agreement to the Board of Directors according to the terms of the letter of intent and assuming project sponsors satisfy all of the conditions specified in the letter of intent and term sheet. Second, although a significant percentage of funds actually committed by contract to assist projects is likely to be expended, such outlays for the most part will not occur until the 1990's, and in the following decade most of these outlays will be recaptured. Thus, the budget impact of the Corporation's program during the 1980's is extremely modest, probably less than $2.5 billion over the entire decade.

With regard to shale, a letter of intent has been signed with Union Oil Company for Phase II of its Parachute Creek Shale Oil Program. This project will give the country operating experience with a next generation surface retort technology, Union C, which is expected to have significant operating efficiencies and substantially improved economics over the first phase B retort. The project's economics will be further enhanced by advantages of scale. The full Phase II component has a design capacity of some 42,000 barrels per day, more than four times the 10,000 barrel per day capacity of Phase I. A price guarantee assistance award of $2.7 billion has been negotiated.

The Cathedral Bluffs project continues in contract negotiations with the Corporation for loan and price guarantees in the total amount of $2.19 billion, as provided in the letter of intent. The project plans to use Union's surface retorting technology in conjunction with Occidental's modified in situ process to reach the deep shale deposits of the central Mahogany Zone of the Green River Basin. The in situ technology will initially be a limited part of the overall project; however, assuming the in situ process works as designed, it is planned to become the project's principal technology.

The Seep Ridge project proposes to use the LOFRECO in situ process on thin, shallow shale deposits in Utah. This technology should be broadly replicable in western shale and possibly in shallow eastern shale deposits as well. The project is seeking loan and price guarantees in the total amount of $45 million.

In the coal resource the Corporation has executed assistance contracts with two projects. The Cool Water project in Daggett, California uses a Texaco gasifier which operates on eastern or western bituminous coal, while the second project, Dow Syngas, located in Plaquemine, Louisiana, can process either lower rank western subbituminous coals or lignite to produce gas. It might be helpful to note here that the Corporation is mindful that many proponents of the Energy Security Act envisioned liquids rather than gas as the principal product from coal and oil shale. But in formulating the Act Congress placed responsibility for determining a project's technology, products, and marketing decisions clearly with its industry sponsors. The Corporation has been careful not to interfere with such private sector decisions. And the fact is, at present, the most economic product from coal is likely to be medium Btu gas. At the same time, however, it should be understood that gasification is a critical step in any liquefaction process; thus, experience with a number of gasifiers and processes will necessarily advance our ability to produce liquids.

The Cool Water combined cycle gasification project was the first to be awarded assistance by the Corporation; the project is now in start-up. On May 20 Cool Water produced its first electricity from coal synthesis gas. The combined cycle process is among the cleanest for deriving energy from coal; it can be replicated by virtually any utility in the country; and it has the particular advantage of allowing a utility to add generating capacity in increments of 100-200 megawatts, a real economic advantage to both producers and consumers. The project has a price guarantee of $120 million.

The Dow Syngas project will produce medium Btu gas from western subbituminous coal initially, although the project has the potential to switch in later years to Gulf Coast lignite as its principal feedstock. The synthesis gas will be used for industrial purposes and to generate electricity. The project, which has a contract for price guarantee assistance in the total amount of $620 million, has the potential to be replicated four times on site and up to 100 times within the surrounding industrial area.

The Great Plains project in Beulah, North Dakota will utilize western lignite to produce 125 million cubic feet per day of high Btu gas (23,100 BOED). The project is over 98 percent complete, on schedule, and under budget. Start-up has begun and the facility is expected to be fully operational by January 1985. The Corporation has signed a letter of intent with the project for a price guarantee in the amount of $790 million. As a condition of this assistance, the sponsors have agreed to reinvest all tax benefits and profits for three and a half years from the date of execution of a financial award contract with the Corporation. All such monies will be applied directly against the project's debt guaranteed by the Department of Energy.

The Northern Peat project in Maine is negotiating a contract for loan and price guarantees in the total amount of $365 million. The project uses a Wet Carbonization process to produce peat-derived fuel which will directly replace imported oil. This process is applicable to the country's substantial peat resource in the Norther Tier, which has a recoverable potential of 25 billion barrels of oil equivalent; the technology is also potentially applicable to the Alaskan peat resource, which has an estimated recoverable potential of 33 billion barrels of oil equivalent.

To attract additional coal projects the Corporation has three solicitations currently open. These are a solicitation for coal-water mixture projects, a solicitation for retrofit projects, and a fourth general solicitation under which all resources eligible in the Energy Security Act may apply. We propose to make two awards for coal-water mixture projects, one for an industrial boiler at a 1,000 BOED minimum size and one for a utility application at a minimum size of 3,000 BOED. In the general solicitation we also propose to make two awards, one specifically to a project using eastern coal and one to the most competitive and programmatically significant additional project in the solicitation. We are particularly seeking projects utilizing eastern coals in fluidized bed and/or slagging Lurgi technologies. The three solicitations close in June and, assuming there are no radical changes in the Corporation's mandate and that the Board of Directors is reconstituted, we would expect to have these remaining coal projects negotiated by the end of 1984.

Within the tar sands/heavy oil resource the Corporation has authorized letters of intent for two heavy oil projects, in California and Texas, which propose to use different technologies. We have also authorized a letter of intent for a Kentucky tar sands project, and we continue to seek one additional major western tar sands project. Such projects are eligible to apply in the fourth general solicitation.

* * * *

Briefly, then, this is the scope and estimated cost of the Corporation's proposed projects program, as outlined in the basic business plan. There is little doubt that, solely from a business point of view, we can implement this program within 9-12 months. But whether we succeed is more likely to be determined by the resolution of two non-business issues. One is this matter of "$67 per barrel oil," which is a number as complex as it is misleading. The other is the matter of directors for the Corporation.

Consistent with the purposes of the Energy Security Act, the Corporation provides loan and/or price guarantees to synthetic fuels facilities to accelerate their development and to assure their ultimate long-term commercial viability. In negotiating assistance we seek to structure a package which enables the project to repay its capital costs within the price assistance period, usually 5 to 10 years. Consequently, the price supports have to be significantly above market, but most of the revenues during this period must be used to retire debt rapidly. In the case of price guarantees only, revenues are used for capital recovery along with a modest return. Thus, at the end of the price support period the project is usually debt free, revenues are anticipated to exceed operating costs, and the project should operate profitably for another 20 to 25 years.

Further, every contract the Corporation negotiates carries a "taxpayer recovery" or recoupment provision. I believe this is one of the most important and innovative elements in the Corporation's approach to assistance contracts. The theory is that, while the Corporation will provide project sponsors protection on the downside of energy prices, we will in turn share on the upside as energy prices rise in more distant years. Basically, taxpayer recoupment provides that as energy prices rise above agreed-to levels, which include reasonable profit margins, a percentage of these higher profits is returned to the Corporation to offset earlier price guarantee payouts. Thus, under the Corporation's median energy price forecasts, we will pay out only small amounts between now and 1990, probably somewhat less than $2.5 billion. From 1990 to 1999 the Corporation anticipates expenditures of roughly 70 percent of the total price guarantee commitments. Over the following decade, however, almost all of these monies will be recaptured, under the "taxpayer recovery" provisions of our contracts.

The aggregate impact of these provisions can be seen in an analysis of estimated net outlays in the Corporation's present program, as defined by those projects awarded contracts and authorized letters of intent. The total obligational commitment for these ten projects is $7.9 billion. While we estimate approximately $4.0 billion will be expended between 1990-1999, we also estimate substantial contract recoupments between the years 2000 to 2010. Thus, at the end of 25 years the estimated cumulative net outlays (payout minus recapture) for the Corporation's original $7.9 billion commitment are only $219 million. Moreover, if energy prices actually turn out to be higher than the Corporation's conservative projections, then the government could actually make a profit on its investment in the commercialization of synthetic fuels.

The Union project provides a good example of how the Corporation's assistance/taxpayer recovery provisions work, as well as an illustration of how learning benefits and economies of scale improve a project's economics. The net present cost of Corporation assistance to Union's 10,000 barrel per day Phase I project over its lifetime is $1.74 per barrel. For Phase II of the project, the net present cost of lifetime assistance is 65 cents per barrel, not $67 as has often been quoted. Moreover, these estimates do not take into account taxes of up to 50 percent which the Treasury will collect on price guarantee payments, and which will further reduce the total federal assistance cost by up to one-half.

One additional point should be made with respect to the Union project. It clearly illustrates the economic advantages of experience and scale. The Union C retort is more efficient than the earlier configuration; in addition, succeeding increments of the project will gain economic benefit from an in-place infrastructure. These advantages can be seen clearly in the net present cost per barrel figures: for Phase I, cost per barrel is $1.74; for the first increment of Phase II, it reduces to $1.19, and with the second increment, it falls to 11 cents per barrel. Subsequent phases of the project, to a maximum capacity of 90,000 barrels per day, are not expected to require assistance. Such improving costs and market competitiveness should occur in other projects as the country moves up the learning curve of commercial synfuels production.

It should also be understood that none of the above calculations or discussion takes into account the economic benefits to the country from the direct, indirect, and induced jobs which would be generated by commercial synthetic fuel projects. Direct jobs are those immediately related to the construction and operation of each facility; indirect jobs are those generated in associated industries, regional and national, such as the mining, steel, transportation, and heavy equipment manufacturing industries. Induced jobs are those added in the consumer goods and services industries at the local level because of the economic growth associated with the new commercial facility. It has been estimated that direct, indirect, and induced employment per billion dollars of Corporation investment is approximately 65,000 man-years over the life of the project. A Corporation supported commercial synthetic fuels program of approximately $11 billion -- roughly that defined in the basic business plan -- would provide the country an additional 717,000 man-years of direct, indirect, and induced employment.

* * * *

All of this, then, brings us to the single overriding critical fact for the Corporation today: To carry out our program and provide the country with the security of a proven alternative to imported oil, we must have an operational Board of Directors. Directors come through the political process, and I especially ask today, with the greatest sense of urgency, that those in Congress who support a national synthetic fuels effort begin to work closely with the Administration to assure that nominations are forthcoming and that the Senate confirmation process proceeds. I have always been committed to carrying out this program as Congress enacted it; I have never questioned Congress' authority to change or redirect it. At the same time, however, industry sponsors have committed far too much private capital for the government to let the program drift by indecision. Those in the private sector who have been willing to take the risk of partnership with the federal government under the Energy Security Act have a right to expect the government to deal in good faith.

I am personally convinced that the United States needs a synthetic fuels option. This does not mean a massive program, but it does require commercial operating experience with the key resource/technology combinations, as outlined in the Corporation's basic business plan. This program represents the best judgment of the Corporation's directors and staff, on the basis of three years of intensive effort and experience as to what is necessary to satisfy the purposes of the Energy Security Act in a Phase I program. The basic business plan represents our judgment of the optimum mix of projects and the best estimate of their total cost at this point.

From the beginning I have said I will never vote to fund projects which are not individually strong and programmatically significant. At the same time, I believe the government did make a commitment in the Energy Security Act to which the private sector has responded by investing upwards of $2 billion in capital to date. I believe the government must prove itself a consistent and reliable partner with industry in this synthetic fuels effort. This means a program somewhere in the $10-15 billion range, and it means a reconstituted Board of Directors for the Corporation this summer. If government should break faith now, then I think not only synthetic fuels but likely a great deal more will be lost in terms of the country's future technological development, industrial competitiveness, and economic growth.

* * * *

Two further matters remain which I have been asked to address in this testimony: the status of the Corporation's comprehensive strategy, and the need for federal support for "less than commercial" scale facilities.

With respect to the comprehensive strategy, an initial complete working draft is being circulated for review and comment by the Corporation's senior staff. While we continue to work with intensity to complete the strategy document, we also recognize that it can have no standing so long as the Corporation does not have a Board of Directors to review and approve the strategy. Further, once we do have an operating Board, it is likely to take new members some time to review the document and provide input prior to their voting to approve the strategy. Consequently, I have directed staff to maintain a full effort, and we are in the process of soliciting comments on the working draft from industry and guidance from the staffs of the Corporation's oversight committees in Congress. Under the provisions of the Energy Security Act, however, no legally authorized strategy can be submitted while the Corporation is without a Board to approve it..

As to its contents and approach, the first priority of the strategy must be to complete the Corporation's Phase I program by executing contracts for assistance for a diverse set of projects identified in the basic business plan. These pioneer plants will provide the country with a technological, environmental, and economic database on which we can begin to make informed national choices about the right balance between domestic energy production and oil imports.

If our first priority is to complete the contracting process, the second priority of the strategy must be appropriate contract management, so the Corporation can assure that the country receives the full learning and economic benefits of its investment in synthetic fuels.

Third, the strategy will address possible adjustments in the provisions of the Energy Security Act. For example, we estimate that full development of promising new heavy oil technologies could make available up to one million barrels per day of additional new domestic production, and this production could be brought on-line rapidly -- e.g., a substantial portion of this new production should be on line within two to three years of a supply interruption, thus meshing nicely with a full Strategic Petroleum Reserve. To allow Corporation support for such technologies, however, would require revisions to the eligibility criteria in the Energy Security Act.

The fourth priority is to encourage and smooth the transition of a commercial synthetic fuels industry from federal support to free market profitability. Among incentives the Corporation is analyzing are adjustments to the tax codes, private insurance approaches, and the use of completion guarantees. Especially for the less risky second generation plants, market driven incentives may be sufficient to sustain the industry's development without direct federal subsidies. On the basis of data and findings from the start-up and initial operating phases of the first federally assisted plants, the Corporation may include specific legislative recommendations as to which market incentives appear most appropriate and effective.

Finally, and most important from the point of view of the formal requirements of the Energy Security Act, the strategy document will analyze three separate options for addressing the goals of the Act: first, to attempt to assist nameplate capacity in the amounts set forth in the Act's production goals; second, to assist sufficient projects so that their on-site expansion potential equals the Act's production goals; and third, to complete the Corporation's Phase I program and basic business plan, then pause for absorption of the learning benefits from these pioneer plants before proceeding with any further recommendations for additional funding. Ultimately, the Corporation's new Board of Directors will have to choose from among elements of these three options. It is, however, already possible to state that greater diversity and expansion potential is possible with the second option rather than the first, and that it is not possible to obtain nameplate, on stream production capacity of two million barrels per day under current market conditions within the funding and other legal constraints of the Energy Security Act.

* * * *

Concerning the "gap" in federal support for technology development, the Corporation's experience does suggest that some form of assistance would likely speed the development process. Whether such assistance could be limited solely to private sector incentives is a question we are examining in the comprehensive strategy, as mentioned earlier in this testimony. At present the Energy Security Act specifically prohibits the Corporation's supporting subcommercial facilities, except as a joint venture assisted module designed to allow on-site expansion to a full commercial facility. While the Corporation is specifically barred from supporting less than commercial plants, the Department of Energy has shifted its efforts toward the earlier, more fundamental areas of basic and applied research. Consequently, an important area in the technology development process, that of semiworks, is now without any form of federal support.

Technology is "proven" in the research and development stage. But to move from this level directly to commercial operation would require a scale up factor of 100 to 200. And this would present unacceptably great technical, mechanical, and cost risks. This has been well documented in a series of studies undertaken by the Rand Corporation, including particularly Understanding Cost Growth and Performance Shortfalls in Pioneer Process Plants.

By definition, semiworks are the process step between pilot plants and commercial facilities. The pilot plant is designed to run a specific program over a range of operating variables to elicit basic design information. As the next step in design development, the semiworks plant looks at correlations for increasing size at the selected design conditions, and the plant runs for relatively long periods, usually six months to two years, at steady state to test critical equipment.

Semiworks allows a technology to be tested at an intermediate scale. For instance, Texaco gasifier pilot plants ran at 5 tons per day and 20 tons per day; the semiworks plant ran at about 200 tons per day; the commercial plant is designed for about 1000 tons per day. This progression in scale substantially minimizes the risk involved in pioneering technology.

At the Corporation we share the prevalent view that some form of federal support is probably necessary if the country is to maintain its leadership role in new technology development. One approach may be to revise the Corporation's joint venture assistance authority under the Energy Security Act to allow semiworks assistance, particularly if this were part of an overall design plan for a commercial facility. An alternative approach would be to broaden the Department of Energy's research program specifically to include funds for supporting semiworks development of new fossil energy technologies. But in making such determinations Congress must ultimately address the national policy issue of what form the federal role should take. That is, should we continue the traditional federal grant/cost sharing approach to new technology development, or should we look to incentives more directly attuned to market economics and private sector decision-making. These are questions the Corporation is examining in the comprehensive strategy.

* * * *

This, then, is the status of the Corporation's program. In business terms, we are close to completing a portfolio of economically promising projects which have technology and resource diversity and which will give the country significant experience in the commercial production of synthetic fuels, as prescribed in the Energy Security Act.

To complete the awards process, however, the Corporation must have funding authority and a functional Board of Directors. The private sector has committed upwards of $2 billion in capital to develop the various projects pending before the Corporation. I believe government in turn has a responsibility to maintain its commitment under the Energy Security Act. Synthetic fuels are an investment in America's future and an insurance policy against economic disorder. This program represents a genuine effort by government to work with and through the private sector to achieve important national goals. It is succeeding; it should be allowed to proceed.

May 30, 1984 (Revised)

UNITED STATES SYNTHETIC FUELS CORPORATION

BASIC BUSINESS PLAN

	Estimated Obligational Authority ($ Billions)	Resource	Technology	Nameplate Production Capacity (BOED)	Ultimate Site Production Expansion Potential* (Minimum)	Product	Status	Net Present Cost of SFC Assistance ($/bbl)**
Basic Oil Shale Program:								
Union I	$ -----	Colo.shale-Mahogany zone	Union B	10,400	------	Upgraded shale oil	Has a $0.4 billion price guarantee transferred to the Corporation from the DOE	$1.74
Union II	2.700	Colo.shale-Mahogany zone	Union C	42,152	90,000	Upgraded shale oil	Letter of intent executed	0.65
Cathedral Bluffs	2.190	Colo.shale-deep deposits	Modified in-situ and Union B	14,100	100,000	Upgraded shale oil	Letter of intent executed	1.99
Seep Ridge	0.045	Utah shale-shallow deposits	True in-situ	1,000	8,000	Raw shale oil	Letter of intent authorized	2.11
	$ 4.935			67,652	198,000			
Basic Coal Program:								
Cool Water	$ 0.120	Western bituminous coal	Texaco	4,300	8,600	Medium-BTU gas	Under contract (price guarantee)	2.17
Great Plains	0.790	North Dakota lignite	Lurgi	23,100	92,400	High-BTU gas	Letter of intent executed (also has a $2.02 billion loan guarantee contract with the DOE)	0.80

---

* The estimates of ultimate site expansion potential are based on current Corporation staff opinion on the land, water and resource availability for each project and the assumption that appropriate mitigation of environmental limitations, if any, is possible. The estimates should in no way be considered as reflective of the sponsors' current planning for site development.

** Present value of deflated cash outlays, net of profit sharing, discounted at 10% per year -- $ per barrelof production over project life.

	Estimated Obligational Authority ($ Billions)	Resource	Technology	Nameplate Production Capacity (BOED)	Production Expansion Potential* (Minimum)	Product	Status	Cost of SFC Assistance ($/bbl)**
Dow Syngas	$ 0.620	Western subbituminous	Slurry-fed, entrained bed gasification furnished by Dow***	5,172	20,670	Medium-BTU gas	Under contract (price guarantee)	$3.28
Northern Peat	0.365	Maine peat	J.P. Energy Oy Peat Wet Carbonization Process	2,745	2,745	Peat-derived fuel(pellets)	Letter of intent executed	2.82
Coal-Water Mixture projects (one industrial and one utility project)	0.150 (est)	Unknown	Unknown	4,000 min.	4,000 min.	Coal-water mixtures	Under solicitation	
Additional coal projects	up to $ 2.955							
a. Fourth General Solicitation (coal award)		Eastern or midwestern bituminous coal	Unknown	6,500 min.	6,500 min.	Various	Under solicitation	
b. Projects from Retrofit Solicitation		Unknown	Unknown	6,000 (est)	6,000 (est)	Unknown	Under solicitation	
c. Additional projects from Fourth General Solicitation		Unknown	Unknown	Unknown	Unknown	Unknown solicitation	Under	
	up to $ 5.000			(est) 51,817 min.	(est) 140,915 min.			
Basic Tar Sands/Heavy Oil Program:								
Kentucky Tar Sand	0.543	Eastern tar sands	Dravo solvent extraction	5,600	16,800	Bitumen	Letter of intent authorized	2.65
HOP Kern River	0.100	California heavy oil	HOP heavy oil process	3,891	3,891	Heavy oil	Letter of intent authorized	0.56
Forest Hill	0.060	Texas heavy oil	Oxygen fire-flood	1,870	1,870	Heavy oil	Letter of intent authorized	1.38
One Western Tar Sands Project	0.400 (est)	Western tar sands	Unknown	5,000 min.	35,000 min.	Bitumen	Under solicitation	
	$ 1.103			16,361 min.	57,561 min.			

	Estimated Obligational Authority ($ Billions)	Resource	Technology	Nameplate Production Capacity (BOED)	Ultimate Site Production Expansion Potential	Product	Status
USSFC Program:	up to $ 11.038			135,830 min.	396,476 min.		
Additional coal/shale/ tar sands/heavy oil projects and reserve for contingencies;	$ 3.732			Unknown	Unknown		
Total Program:	up to $ 14.770			135,830 min.	396,476 min.		

May 24, 1984

Synthetic Fuels Corporation
Median Estimated Net Outlays for Agreements,
Letters of Intent and Authorized Letters of Intent

Executive Summary ·

The attached Schedule A displays the estimated cash outlays of the United States Synthetic Fuels Corporation (SFC) through the year 2010, net of profit and revenue sharing payments, for existing SFC commitments. Current SFC existing commitments include projects under contract, projects having executed letters of intent, and projects for which the Board has approved letters of intent. Projects which might receive the remaining $7.2 billion of SFC obligational authority under the Third General Solicitation, Fourth General Solicitation, the Coal-Liquids Solicitation, or the Retrofit Solicitation, now underway, are not included. The figures are expressed in then-current dollars without discounting. A brief listing of key assumptions upon which they are based is attached. Schedule A does not include any direct corporate income tax effects for the Government.

The forecast indicates that the aggregated net outlays of the SFC for these projects will be only $218 million by 2010 even though $7.9 billion will have been obligated. It should be noted that the total outlay estimate is from a relatively conservative assumption of crude oil price growth of 1.4% per annum in real terms for 2000-2010, the principal profit sharing period. A more rapid increase of crude oil prices could further diminish the total outlays. The attached assumptions schedule compares the SFC median crude oil price growth assumptions to the DOE estimate.

A brief summary of the schedule follows.

Summary
SFC Existing Commitments Median Net Outlays

	Number of Projects	Total Obligational Authority	1984-2010 Outlay Total
Agreements in Force	3	$1,140	$1,026
Letters of Intent-Executed	4	6,045	(961)
Letters of Intent-Authorized	4	748	153
Total Existing Commitments	11	$7,933	$ 218

Definitions

Price Guarantee Payment -- the amount paid by SFC to a project. This amount is generally equal to the actual sales volume multiplied by the amount, if any, by which the negotiated support price per unit exceeds the stipulated market price per unit of the project's Eligible Product. Total Price Guarantee payments are limited to a negotiated total maximum amount and also to a maximum duration of 10 years after plant start-up.

Profit Sharing Receipts -- payments by a project to SFC based upon a negotiated formula. Typically, Profit Sharing begins after the project recovers its capital with subsequent payments to SFC of a share, e.g. 70%, of future profits.

Median Projection Net SFC Outlays -- the attached schedule is a forecast of net SFC outlays, which are equal to annual SFC Price Guarantee payments to projects reduced by annual Profit Sharing Receipts to SFC. These net outlay estimates include 5.5% annual inflation and have not been discounted.

Projects Included

Three levels of projects are included in the forecast. They are signed financial assistance agreements, executed letters of intent and authorized letters of intent under negotiation. Signed agreements are those projects which have firm contracts with the SFC for financial assistance. Executed letters of intent represent those projects that have reached agreement with the SFC on the major terms of financial assistance and are now preparing final contracts for Board approval. Authorized letters of intent include those projects that have passed all the SFC reviews, reached agreement on the aggregate level of assistance, are negotiating the terms of the agreement, and the Board has authorized the Chairman to execute a letter of intent. In total, the three categories include 11 projects and total obligations for financial assistance of $7.9 billion. All but one of the projects has funds set aside for it by the U.S. Treasury.

Column I

The total obligational authority represents the maximum level of combined assistance, loan and price guarantees, provided to the respective project. Financial assistance to the project cannot exceed its maximum.

Columns II-VIII

The forecast of outlays represent the SFC's median estimates of project performance based on each project's unique operating characteristics. The outlays are net of any Profit Sharing Receipts to be paid to the SFC. The Profit Sharing Receipts permit the SFC to partially recover its financial assistance payment by receiving payments from the project after it has passed a threshold level of financial performance. The outlays are aggregated by specific time periods (Columns IV-VII) to show the cycle of funds flow between the SFC and the projects.

Income Tax Effects

It should be noted that these estimates ignore the fact that for a fully taxable project owner roughly 50% of the payments would be returned to the Government through income tax. Accordingly, the outlays and receipts would be decreased by one half.

Key Assumptions

All project estimates are based on the SFC median economic scenario forecasts of petroleum product prices, interest rates and inflation.

Schedule provides net SFC outlays, which are SFC Price Guarantee payments to projects net of SFC receipts from Profit Sharing. These estimates are in inflated (out-of-pocket) dollars based on a general inflation rate of about 5.5% Each year's amount has not been discounted.

SFC analysis of possible project abandonment indicates that the projects are forecast to be economically viable over the indicated project life.

SFC Crude Oil Price Assumptions -- A crucial element in these forecasts is the real growth in crude prices. The outlay estimates are prepared using the SFC's median crude oil price projections which represent the mid-range of private and government forecasts. The following compares the base case SFC median annual compound real (i.e. uninflated) growth in market crude oil prices to the DOE April 1983 estimate.

	1984-2000	2000-2010	1984-2010
DOE(NEPP IV) Reference Case	4.4%	4.0%	4.2%
Synthetic Fuels Corp. Median 1/	2.5%	1.4%	2.2%

1/ Average compound annual real growth rates (i.e. excluding general inflation)

Median Estimated Net Outlays 1/
$ in Millions 2/

Agreements in Force	I. Total Obligational Authority	II. FY 84 3/	III. FY 85-89	IV. FY 84-89 Total	V. FY 90-99 Total	VI. Subtotal FY 84-99	VII. FY 2000-10 Total	VIII. Total
Union I	400	2.0	341.6	343.6	56	400	-	400
Cool Water	120	1.0	119.0	120.0	(55)	65	(58)	7
Dow Syngas	620	-	158.0	158.0	461	619	-	619
Subtotal	1,140	3.0	618.6	621.6	462	1,084	(58)	1,026
Letters of Intent Executed								
Shale Projects	4,890	-	93.5	93.5	3,780	3,873	(2,670)	1,203
Coal/Peat Projects	1,155	-	773.9	773.9	(463)	311	(2,475)	(2,164)
Subtotal	6,045	-	867.4	867.4	3,317	4,184	(5,145)	(961)
Letters of Intent Authorized								
Shale Projects	45	-	29.2	29.2	7	36	(1)	35
Tar Sand/ Heavy Oil Projects	703	-	194.9	194.9	193	388	(270)	118
Subtotal	748	-	224.1	224.1	200	424	(271)	153
Total 4/	7,933	3.0	1,710.1	1,713.1	3,979	5,692	(5,474)	218
Memo: Financial Assistance Fees		(2.2)	(16.5)	(18.7)				

Obligational Authority by Resource Allocation:

	Amount	%
Shale	$5,335 MM	(67.2%)
Tar Sand/Heavy Oil	703	(8.9%)
Coal/Peat	1,895	(23.9%)
Total	$7,933 MM	(100%)

1/ Sign Convention: (i) Positive indicates SFC net outlay (ii) brackets indicate net SFC receipt (i.e., Profit Sharing and fees exceed SFC Price Guarantee payments).

2/ Amounts are in then-current dollars.

3/ Fiscal Year is the period October 1 through September 30.

4/ These estimates ignore the effect of corporate income taxes.

Finance Group
[illegible]

1586F/p. 20

SFC Project Solicitation Schedule

	1983	1984												1985
	DEC	JAN 5	FEB 2/16	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1st QTR
3rd GENERAL SOLICITATION					TERM SHEETS DEADLINE			CONTRACT AWARDS DEADLINE						
COAL-WATER FUEL SOLICITATION		FORMAL ISSUANCE OF SOLICITATION					SUBMISSION OF QUALIFICATION PROPOSALS	IDENTIFICATION OF QUALIFIED PROPOSALS		FULL CAPITAL COMMITMENT			TERM SHEETS DEADLINE	CONTRACT AWARDS DEADLINE
GENERAL COAL GASIFICATION SOLICITATION	TENTATIVE ISSUANCE OF SOLICITATION	FORMAL ISSUANCE OF SOLICITATION	SUBMISSION OF PROPOSALS/ IDENTIFICATION OF QUALIFIED PROPOSALS		TERM SHEETS DEADLINE				CONTRACT AWARDS DEADLINE					
RETROFIT SOLICITATION		TENTATIVE ISSUANCE OF SOLICITATION	FORMAL ISSUANCE OF SOLICITATION				SUBMISSION OF QUALIFICATION PROPOSALS		IDENTIFICATION OF QUALIFIED PROPOSALS		TERM SHEETS DEADLINE		CONTRACT AWARDS DEADLINE	
4th GENERAL SOLICITATION		TENTATIVE ISSUANCE OF SOLICITATION	FORMAL ISSUANCE OF SOLICITATION				SUBMISSION OF QUALIFICATION PROPOSALS			IDENTIFICATION OF QUALIFIED PROPOSALS		TERM SHEETS DEADLINE		CONTRACT AWARDS DEADLINE

USSFC – 4/20/84

EDWARD EVERETT NOBLE

Home Address:	2419 East 72nd Place Tulsa, Oklahoma 74136 (918) 496-3062	Business: Address	U.S. Synthetic Fuels Corporation 2121 K Street, N.W. Washington, D.C. 20586
PERSONAL:	Born: March 19, 1928 Ardmore, Oklahoma	Children:	Ben Edward Noble Vivian Noble Richardson

EDUCATION: St. John's Military Academy, Delafield, Wisconsin; B.S. Degree in Geology, University of Okahoma, Norman, Oklahoma; Reserve Officer, United States Army

CURRENT BUSINESS AFFLIATIONS: United States Synthetic Fuels Corporation - Chairman of the Board.

PAST BUSINESS AFFLIATIONS: Director, Noble Affliates, Inc., Ardmore, Oklahoma - Oil exploration, contract drilling, production and heavy equipment.

Chairman of the Board of Lenox Square Inc., Atlanta, Georgia - Management of large regional shopping center.

Director, SEA Cattle Company, Ardmore, Oklahoma - Ranching, farming and oil development.

Quality Shell Fish Inc., Middletown, Rhode Island Director - Processing and distributing shellfish.

President and Chairman of the Board, Marketing and Research Development Inc., Atlanta, Georgia - International trading company.

Chairman of the Board, Noble Inns Corp., Atlanta, Georgia - Hotel development and management company.

Director and Principal Stockholder, Auto Crane Co., Tulsa, Oklahoma - Manufacturer of electrical and hydraulic cranes for heavy equipment industries.

Director, Associated Distributors, Atlanta, Georgia - Management service for home and commercial building material stores.

OUTSIDE INTERESTS: Hoover Institute on Revolution, War and Peace, Stanford University, Palo Alto, California - Board of Overseers.

Trustee, The Samuel Roberts Noble Foundation Inc., Ardmore, Oklahoma - Research of degenerative diseases (primarily cancer) and agricultural research.

Chairman, Council on Economic and National Security, Washington, D.C.

Member, Defense Orientation Conference Association, Washington, D.C.

Founding Director, The Southern Council for International Studies, Atlanta, Georgia.

Member, Young President's Organization, New York, New York; Member, Chief Executives Forum Inc., West Palm Beach, Florida.

Director, Pace Academy, Atlanta, Georgia.

Mr. FUQUA. Thank you very much, Mr. Noble.

The—what, in your opinion, is the effect of the market price language in the administration's proposed legislation? You were here, you heard the discussion that I had with Secretary Boggs about the impact of that. And what impact would it have on the management ability of—of the SFC?

Mr. NOBLE. Well, I, frankly, sir, would need a better definition of what they mean by market test. It is very vague. It does fly in the face of our section 134 of the Energy Security Act. And I believe that it would eliminate most of the long-term technically potential programs, particularly in the coal area, and——

Mr. FUQUA. Well, how does it vary from what your criteria is today that you use?

Mr. NOBLE. Well, like I said, I have had no definition of that, and I would like to have a definition of it. I know my friend Don Hodel said that it would eliminate 9 of the 10 programs that are in front of us. Now, but as I said, it's vague. I really do need a definition of that because I think it puts a real burden on the Directors to make a judgment of that kind when you have something that is as vague as, quote, "market test." But I respect that and I would like to have a definition of it.

But as I see it, it probably would eliminate virtually everything.

Mr. FUQUA. Well, it——

Mr. NOBLE. But——

Mr. FUQUA. How about those projects that already have an existing commitment?

Mr. NOBLE. The projects that are under contract, no. As I understand—that would not——

Mr. FUQUA. Would not affect on——

Mr. NOBLE [continuing]. Would not affect the Dow project or the Cool Water project. I have my counsel here on the right. If he—has any comment, would that——

Mr. LIPKIN. Right. I would just like to say——

Mr. FUQUA. Would you—would you identify your name, please, for the reporter?

Mr. LIPKIN. Yes, sir, my name is Jeffrey Lipkin, and I am the General Counsel of the Corporation.

Mr. FUQUA. Thank you.

Mr. LIPKIN. I guess my personal opinion about the market test is that it would create an unworkable situation for any principled Directors of the Corporation. Under the legislation as it's written, there's a 10-year limit on the period to which we can commit price guarantees in advance.

There is also a requirement that projects be for commercial production. And we have interpreted this as requiring that we expect the projects will continue to produce synthetic fuel and provide infrastructure and learning benefits after the 10-year period of assistance.

With these two constraints, we have negotiated our transactions so that the debt of the projects is paid down in the 10-year period. And this, of course, requires fairly higher support levels in the $40 to $60 a barrel range for the first 10 years.

During the last 20 years of a project's life we get profit sharing that results in recovery of most, if not all, of the moneys that we had put out.

Mr. FUQUA. Uh-huh.

Mr. LIPKIN. But since no one can predict oil prices, it doesn't make sense to leave a large debt burden on a project after our assistance has run out.

Now, if I were a director and I were looking at $40 to $60 a barrel for the first 10 years, I would have trouble saying that wasn't substantially above market price. I think I can make a legal argument that you might be able to stretch and do it but I think it would be very difficult.

I guess the second disagreement I have with Mr. Boggs is that I don't think that—or particularly Mr. Hodel, who reported that he thought the Great Plains project might pass the test but the others would not—is that I don't think the test really separates out Great Plains.

If you look at the letter of intent for Great Plains, you are looking at $40 to $60 dollar a barrel support levels. And really if you look at any test of the cost of the Great Plains assistance over market, it falls within the middle of the range of the letters of intent that we have.

So, for both these reasons I think the test probably isn't a significantly helpful addition to our act.

Mr. FUQUA. Mr. Noble, in—can you explain why your support prices appear so high compared to your estimate of cost per barrel over the life of the project?

Mr. NOBLE. Yes, sir, I think I can. And I have my financial officer here if it needs a little more clarification. But, frankly, as Mr. Lipkin said, our effort here is to have a few plants—and I think that was the intent of the Energy Security Act, to have a few plants that were demonstrating a capability that would in effect kind of set a top out there for the exporting countries to be looking at. Because in this country, while we do have a shortage of liquids—and we're importing about a third of our liquids, and those liquids represent only 2 percent of our reserves; whereas, 90 percent of those reserves are in solid fossil energy, coal, so forth—I have made this talk several times. But six times as the reserves of the Middle East, in mineable solid fossil energy reserves is not something that the exporting countries of the world shouldn't look at very carefully, particularly if we've got a few plants out there showing that we can do it; and that's all we're attempting to do. And what we have used these price supports in a way that in the early years we pay, as in the Great Plains project, somewhere $40 to $58 a barrel, equivalent, for this gas. But at the same time, we're asking those people to put back into that project, while we're putting out almost an equal amount of money in their tax benefits, so that that project is virtually paid off by the midnineties, about 1993, 1994—that project will be paid off, when the assistance is out. And then it can operate very commercially and actually pay a profit back to the taxpayers. And we have negotiated profit sharing after the money—after it's paid off.

And in that particular case it represents substantial profits back to the taxpayers. And we think that this is a very sound way to try to get energy security, an insurance policy, in front of the country. But those initial payments that you spoke of during the payout period are higher than the market. And, again, as Jeff Lipkin just said, if in effect the Great Plains project does qualify, then virtually all of them will qualify because they have not been treated so much differently than—each one is different—but not too significantly that—at least the ones in front of us, I think would qualify.

So I do need a more definite clarification of that word—term "market test."

Mr. **Fuqua**. Uh-huh.

Mr. Boggs stated about the $1.2 billion from the TOSCO project that there was some disagreement over, whether or not that could be used by the SFC. Can you explain what solutions are underway to try to resolve that dilemma?

Mr. **Noble**. Well, as I understand it, the GO—GAO has agreed with us that it is returnable, that it was not spent, and it is returnable as usable funds.

I think the Treasury has not yet rendered their opinion. Is that correct, Jeff?

Mr. **Lipkin**. Yes, sir. The GAO did agree with the opinion of the Corporation's counsel that the bulk of those moneys, all but $78 million, are available to the Corporation now. We wrote the Treasury Department and asked them for a concurrence that this is indeed now the case, and we have not yet received a response from them. They had earlier taken the contrary position in their General Counsel's office and I don't know whether they will reverse that.

Mr. **Fuqua**. Uh-huh.

Mr. Noble, if the SFC funding is reduced by some amount, it would indicate that no further funding is anticipated. And if that were the case, what purpose would be served by some comprehensive strategy?

Mr. **Noble**. Well, I think the comprehensive strategy would be very important in that it reflects what we have learned and what we would suggest for the future. And this is really, as I understand, the intent of that comprehensive strategy is to—is to kind of convey to the future decisions of Congress as to whether or not you do want a second phase, or if you want to wait and get the learning curve, and what, in fact, have we learned during this period. And I think it would be helpful.

Mr. **Fuqua**. Well, what kind of technologies do you think that may be in need of the semiworks assistance?

Mr. **Noble**. I'd like Jeff—I mean, Mr. Axelrod to comment on that in specifics. I do think that there is a place for a semiworks plant or a subcommercial plant which—actually what you are talking about is reducing the risks before you go to the massive commercial scale plant. And anything you do to reduce risks, I think pays off in the long run.

Len, do you want to specifically address that?

Mr. **Axelrod**. I have one. The first technology that comes to mind, and I think that's it at the front of everybody's mind, is that of direct liquefaction of coal. There have been some semiworks plants on two technologies. No one has seen fit to move forward with those technologies. We do know that there are at least three, possibly four, research and development activities going on, bringing forth, we hope, in the near term, substantial improvements in the cost of making liquids by direct hydrogenation of coal.

When those come out of the pilot plant stage, there will be a need to go into some type of larger pilot plant or semiworks operation to reduce the risk before going to commercial operation.

Mr. FUQUA. Well, has there been much support expressed by industry for the need of these semiworks facilities?

Mr. AXELROD. Well, industry generally——

Mr. FUQUA. I'm not talking about the vendor, but the——

Mr. AXELROD. No, I'm talking——

Mr. FUQUA [continuing]. The user, for the end product.

Mr. AXELROD [continuing]. Talking about industry in their own processes, in the work that they normally do usually work in that fashion; when they are bringing new technologies into commercialization they will go through several small pilot plant stages, then to an intermediate size, and finally to a commercial size.

Mr. FUQUA. But I—now, how does that fit into the—the SFC's overall plans?

Mr. AXELROD. Well, this came up as a corollary of looking at our basic business plan, and looking at the comprehensive strategy to see what was available in the future. As opposed to what the agencies must do, where they have to work on a year-to-year budget, we are looking at strategy for 5 or 10 years, recognizing that what's done in research and development won't reach commercialization for 7 to 10 years at the earliest.

Mr. FUQUA. Uh-huh.

Mr. AXELROD. And so we felt that while the basic business plan, which I think you are familiar with, was being put into place in terms of completing the design, the construction, getting the startup, and getting them operating, there may be in many areas, not just the direct liquefaction of coal, new technologies emerging from the development stage sometime during that 5- or 10-year period, and some means ought to be available for advancing them forward.

Mr. FUQUA. Well, what—what do you see as the advantages or disadvantages of the semiworks funding being from DOE or from SFC?

Mr. AXELROD. I don't really see that there's advantages or disadvantages that I ought to talk about at this point. All—our point is, is that it's apparent that some provision is going to have to be made for semiworks operations for new technologies.

Mr. FUQUA. From one or the other——

Mr. AXELROD. From one or the other.

Mr. FUQUA [continuing]. The DOE or the SFC?

Mr. AXELROD. Yes, sir.

Mr. NOBLE. Or some sort of private sector initiative, sir. We are not looking for new territory.

Mr. FUQUA. Well, if they are not funded in the next several years, what effect do you think it is going to have on our future technologies?

Mr. AXELROD. Well, I guess people have been calling this a gap in development. And I think what we will find if we let this become a gap in reduction of research and development, and reduction of semiworks operations, you will get a gap in the continued improvement of technologies.

Mr. **Fuqua**. Uh-huh.

Mr. **Axelrod**. This will be somewhat mitigated by—if we're able to go ahead and put into place the complete basic business plan because the activities engendered just doing that designing and operating, starting up, will come up—will bring a lot of new ideas to the fore.

Mr. **Fuqua**. Mr. Noble, have you received any indication from the administration as to when they might submit some nominees for directorships on the SFC to the Senate for confirmation?

Mr. **Noble**. No, sir, I haven't received any time. I have been told that they will be forthcoming, and I have every hope and belief that they will be.

Mr. **Fuqua**. Thank you.

Mrs. Schneider.

Mrs. **Schneider**. Thank you, Mr. Chairman.

I apologize, Mr. Noble, for having to run out of here. Its been one of those days when I have three hearings going on simultaneously and I have to be everywhere at once.

But I did have the opportunity to check out some of your testimony and I was interested in knowing that right now, the Synthetic Fuels Corporation assumes a real 2.5-percent increase in oil prices through the end of this decade, what's happened to the oil prices in real terms since 1980? I'm just trying to put all of this in an appropriate framework.

Mr. **Noble**. In real terms?

Mrs. **Schneider**. Yes.

Mr. **Noble**. I guess they've been down—I know they've been down. Hod, you've got that. I'd like to ask Hod Thornber, our vice president of finance. They have been down, but I think he can tell you exactly.

Mr. **Thornber**. My name is Hodson Thornber, vice president for finance at SFC.

Obviously, real oil prices have come down dramatically in today's dollars. I suppose the decline must be on the order of 30 or so percent.

In formulating the projections that you referred to, we have taken some care, since we're no better at projecting prices than anyone else, to look very broadly at the projections that are provided from all over the world, since this is a world commodity, and to look at a broad array of price projections.

We look at these projections in very much downside environments, we look at them in upside environments, and in these middle cases of the kind that you referred to. The latter are median, our so-called, price projections, which are that prices will continue to fall slightly in real terms in the next year or two, and that they will then perhaps in 1986 or 1987 follow an upward course at the rate of 2 or so percent.

Mrs. **Schneider**. So the parameters you are using in terms of arriving at an appropriate real term are somewhat similar to those being used by the EIA. But interestingly enough, their projections of future energy prices are considerably lower than yours.

Now, how would you explain that?

Mr. **Thornber**. I don't have the EIA projections in front of me. The projections that I am directly familiar with are from the Department of Energy. And the DOE projections are approximately the same as ours over the next 4 or 5 years, and then move substantially above it to a dramatically higher level in the post-2000 period.

Mrs. **Schneider.** Well, let me say Mr. Noble, we know we are committed right now to price supports on the order of about $67 per barrel. But isn't it true that your projections of $6 billion of income being returned to taxpayers is based on some specific assumptions?

Mr. **Noble.** Yes, ma'am.

Mrs. **Schneider.** And those assumptions are what I'd like to run through right now with you. You mentioned that one of those assumptions is certainly how well those plants are going to operate if they live up to our production capacity. That's a pretty iffy assumption.

Mr. **Noble.** This is another reason that we've taken—for two reasons—we've taken more time than a lot of people thought might have been necessary; but to insist that the design level of these plants has been perfected to the point that we can have a more reasonable idea that they are not going to have massive cost overruns. And if you look at the history of almost any new technologies and new things that have been developed—and I don't care whether it's, what it is—but that design level has been a very important factor in keeping those costs where you thought they should be in—in the first place. But the $67 a barrel is a very misleading figure. What we've really put it in terms of is—what does the cost of that barrel, over the life of the plant, cost to the taxpayers? And that's where I had to take very big issue——

Mrs. **Schneider.** Yes.

Mr. **Noble.** With—and a respectful difference, for instance, with Mr. Wolpe, that testified earlier.

Mrs. **Schneider.** Well, you see that's——

Mr. **Noble.** And we're talking about very—Hod, I'd like you to explain the 67 cents a barrel as well as this 11 cents a barrel that we've used.

Mr. **Thornber.** Congresswoman, on the question of production rates, the projections that we use for production rates, just to respond to your question, and then I'd like to follow on in the vein the chairman suggested.

We have, as you know, an engineering staff which assesses the likely production rates of these plants, and the projections that we use are, again, median projections. There is in our engineering staffs, you and Mr. Axelrod can certainly speak to this—as much likelihood that the plants will produce more than we have projected, and that they'll produce less. The rates are our best intermediate estimate.

In taking those estimates and as a business matter converting them through the negotiating process into contracts, we have found by the operation of the Energy Security Act the need to provide initial price guarantees on the order of $60 to $67 a barrel. Those are initial contract terms to provide money which is, in the first instance, taxable.

Congressman Fuqua asked why are there so many dollars difference between the stated support price on the one hand, and the effective subsidy on the other. One reason is, for every dollar that is paid out by the SFC, half of it is returned to the Treasury Department 90 days later in the form of a tax payment.

Mrs. **Schneider**. I can appreciate that——

Mr. **Thornber**. The second——

Mrs. **Schneider**. But I'm afraid that we're getting off the track of my original question. And I think some of the assumptions that I was referring to are certainly misleading in themselves.

The first point that you make—we're talking about production capacity and the hope, once again, the hope is an assumption that the technical capability will be terrific. You said that the technical designs have been very carefully scrutinized before saying, well, let's move ahead on it. But isn't it true that the Union Oil shale project is about 6 to 8 months behind because of technical difficulties?

Mr. **Noble**. Yes, ma'am, that's exactly correct. But this is one of the things that—the reasons that you really need to have your first-of-a-kind commercial plants. Let's look at the Sasol plants. They took technology that was literally 20 years old at the time in 1955. It was absolutely proven from a pilot scale point of view. The Germans had used it in dozens of small plants all over Germany. But that plant, when it was first put on line, it was literally 3 years before they got the first drop of production, and they were working 24 hours a day, 7 days a week. It was 6 years before they got up to the design level of the plant. Then when they added the No. 2 plant, which was, I believe, four times larger. That scaleup is not near what we're talking about in the scaleup from a pilot plant to a commercial plant which might be 100 to 200 times larger. It's not that the technology doesn't work. There's literally dozens of things that may not work in the scaleup.

But the Union plant appears to be doing a very good job in working out those technical details that they had there, and I would suspect that within the next few months that they'll be getting that production up.

Mrs. **Schneider**. Well, I——

Mr. **Noble**. But these are the things that you have to go through. Mr. Axelrod, do you——

Mrs. **Schneider**. I can appreciate that, but I think that we have to recognize that 6 to 8 months we're talking time——

Mr. **Axelrod**. What I'd like to——

Mrs. **Schneider**. And that's a delay, and time is money, and——

Mr. **Axelrod**. What I'd like to point out is that 6 to 8 months behind Union's announced schedule, which they announced for some reason or other. But about a year ago, we advised them that we thought they needed to put about 6 months contingency into that schedule——

Mrs. **Schneider**. Uh-huh.

Mr. **Axelrod**. On startup. We thought they were too optimistic. And this is what we normally look for when we review the projects.

Mr. **Fuqua**. Will you yield just a moment?

Mrs. **Schneider**. Yes, I'll be happy to yield.

Mr. **Fuqua**. Am I correct that the clock doesn't start running until Union starts producing oil?

Mr. **Noble**. Absolutely.

Mr. **Fuqua**. A 6-month delay or any increased cost that might result to them is on their time, or their pocketbook, not the SFC's, is that correct?

Mr. **Noble**. The taxpayers don't pay 1 cent until they produce a barrel of oil.

Mr. **Fuqua**. And then that price has already been agreed on?

Mr. **Noble**. Yes, sir.

Mr. **Fuqua**. Prior to—prior to that. So any increased cost that might occur by a delay would not affect the SFC commitment—to a price commitment—to Union?

Mr. **Noble**. That's exactly correct.

Mrs. **Schneider**. But, Mr. Noble, isn't it true that letters of intent are nonbinding and they are nonlegal commitments?

Mr. **Noble**. That is correct, yes, ma'am.

Mrs. **Schneider**. And isn't it also true that in the past, projects have collapsed after the letters of intent were issued?

Mr. **Noble**. That's correct.

Mrs. **Schneider**. Isn't it legitimate to say that those projects which have received letters of intent have not been guaranteed assistance?

Mr. **Noble**. That is correct. Now, let me explain the letter of intent, if I might.

Every project that comes in, they say that they can do certain things. And when we—after we get it to a certain point, then we agree with them, or at least I do, that if they can do certain things that they have said that they can do, then I have agreed that I would recommend certain levels of assistance.

Now, this gives them—these people are spending their own money—often millions and millions of dollars—so it does give them a level of assurance that they can prove that they can do these things.

Now, the letters of intent that are actually in front of the Corporation right now, I'd say most of them are fairly far along in their evaluation. Some of them are even in the position of being able to be documented at this time for contracts. But that doesn't mean that every one of them is going to receive assistance at all.

But it does give them some kind of assurance to go ahead and spend their money, which we use this letter of intent in a way to help the taxpayers not have to pay the burden of proof, so to speak. We make them pay the cost of proof.

Mrs. **Schneider**. Well, part of your assumption when we get back to this—the ultimate cost and the benefit to the taxpayer, in addition to production capacity being terrific—you are also working under the assumption that there will be no further subsidies required. Correct?

Mr. **Noble**. Yes, ma'am.

Mrs. **Schneider**. Now, that concerns me a great deal, as an assumption that just can blow away in no time at all, given the fact that right now Union still can't get on line, and they want higher subsidies to expand—and Great Plains, from what I understand, is already asking for more money. So——

Mr. **Noble**. Now, hold on just a minute.

Mrs. **Schneider**. OK.

Mr. **Noble**. The Union project is not asking for more money, that I know of.

Mrs. **Schneider**. Well, they're asking for money for their second phase.

Mr. **Noble**. The phase II project, let me explain that to you also——

Mrs. **Schneider**. OK.

Mr. **Noble**. That's a very good example of where you get into efficiencies of scale. That Union I, which is a 10,000-barrel-per-day production plant, we have estimated that the assistance of the price of that oil over the life of that plant is a $1.74 per barrel. Now, that is what the Government will pay if our assumptions—and you do make a good statement that the assumptions are not always correct—the spelling of that word assume I won't go into—[laughter]—there's a joke about that.

But assuming that those assumptions—[laughter]—are correct, and we do make fairly conservative assumptions, we are not given, as I mentioned earlier, our assumptions on prices are considerably below DOE's. In fact, our econometric assumptions, I believe, are about as low as anybody's we've looked at. Is that correct, Mr. Thornber?

Mr. **Thornber**. Well, as I've said, we do try to do an objective survey and we hedge the thing with—on the downside, but there are people below us. We're sort of in the middle.

Mr. **Noble**. Union II, which is you're asking about—why do they ask for more money—that first plant, a 23,000-barrel-per-day plant, will use a retort which they feel, and what we think, will be about 65 percent more efficient on an operational basis than their Union B retort. Again, this is what you gain when you get into the commercialization of these plants. That level of assistance is about $1.19 per barrel over the life of the plant.

Then when they go to the second module of that Union II, which is another 23,000 barrel, that level of assistance drops to 11 cents per barrel assisted—an average of about 65 cents per barrel, and that's before taxes, I believe, so about half of that comes back to the taxpayers.

They assume—again——

Mrs. **Schneider**. Assume.

Mr. **Noble** [continuing]. They assume—well, you have to make assumptions in these things, there's no way around that one. But that—from that point on, that these—the commer—the efficiencies of scale that they will be able to make those plants at commercially viable prices without any assistance.

Now, this is why we have the Corporation. If you did not need to have—make these assumptions, if you didn't have any risk, they wouldn't need this Corporation and I could be doing something——

Mrs. **Schneider**. Else.

Mr. **Noble** [continuing]. Maybe more beneficial.

Mrs. **Schneider**. [Laughter.] I won't finish your sentence for you, but I will say this: Just listening to you, there's something that you and I have in common, and what we have in common is that we are both public servants.

Mr. **Noble**. Exactly.

Mrs. SCHNEIDER. We are both answerable to the taxpayer. All I can say is that it makes me very jumpy, very edgy, if I were to put myself into your position, and to—to think that you will feel good about answering to the taxpayer down the line; and once again trying to project—based on the fact that you are working under three assumptions, you are working on the assumption that the production capacity will be on the rise, it will be high; you are working on the assumption that no further subsidies will be necessary and; third, you are working under the assumption that oil prices are going to go sky-high, and——

Mr. NOBLE. No, no, you're——

Mrs. SCHNEIDER [continuing]. And I think that those, you know, certainly——

Mr. NOBLE. May I correct some of your assumptions?

Mrs. SCHNEIDER [continuing]. Puts some very shaky ground under some of your projections.

Mr. NOBLE. No, let me say that I think our projections are very conservative on price. We are talking about flat for the next 2 or 3 years; we are talking about what is it, about one——

Mr. THORNBER. Excuse me, could I just nail one point down on what you've just described?

You are looking at the price projections that were used in characterizing the cost of assistance—the $1.74 figures, and so forth, and that's what they were used for.

In evaluating the viability, the commercial viability of these plants, as I mentioned, we have an array of prices. On the downside they are essentially—the prices don't rise before the year 2010 in real terms at all, and these projects are all put up against those price projections, too. It's only if they pass all of those tests that they are deemed to be viable.

So we're not jumping to any conclusions about sky-high prices when we look at viability.

Mrs. SCHNEIDER. OK. I don't have any further questions, Mr. Chairman. Thank you very much.

Mr. FUQUA. Thank you. Thank you very much, Mr. Noble, and your associates for being here today. We appreciate your being here and answering very candidly some questions about the operations of the Synthetic Fuels Corporation. We appreciate it very much.

Mr. NOBLE. Thank you, sir.

Mr. FUQUA. The hearing will recess until tomorrow morning at 9:30.

[Whereupon, at 12:30 p.m., the subcommittee recessed, to reconvene at 9:30 a.m., Thursday, June 7, 1984.]

THE STATUS OF SYNTHETIC FUELS AND COST-SHARED ENERGY R&D FACILITIES

THURSDAY, JUNE 7, 1984

House of Representatives,
Committee on Science and Technology,
Subcommittee on Energy Development and Applications,
Washington, DC.

The subcommittee met, pursuant to notice, at 9 a.m., in room 2318, Rayburn House Office Building, Hon. Don Fuqua (chairman of the subcommittee) presiding.

Present: Representatives Boucher, Nelson, Fuqua, Schneider, and Bateman.

Staff present: Robert Kripowicz and William Harvey.

[The opening statement of Mr. Fuqua follows:]

Opening Statement of Hon. Don Fuqua, Subcommittee on Energy Development and Applications

Today's hearing is the first of two hearings on the need for cost-shared energy technology facilities. Today we will focus on the fossil energy area. We will hear from William Vaughan, the Assistant Secretary for Fossil Energy from the Department of Energy, and then from Mr. Dwain Spencer of the Electric Power Research Institute (EPRI), and Mr. David Webb of the Gas Research Institute (GRI). EPRI and GRI will also address technologies, other than fossil energy, which will be covered in more detail in the hearing next week.

In the past three years federal energy research and development programs have been re-oriented from an emphasis on near term development, including large scale pilot or demonstration facilities, toward long term, high risk, basic and applied research. It has been assumed that private industry would take over the system testing and demonstration activities previously funded by federal programs.

It is apparent that the real situation is not as cut and dried as has been assumed. There are several demonstrations of technology at pilot or demonstration levels that continue to receive federal funding.

Many of these, such as fuel cells and the EPRI/Tennessee Valley Authority atmospheric fluidized bed combustion demonstration, are continued at Congressional insistence. Also, some technologies have gone ahead without direct federal funding during development.

Several Members of Congress, who have already testified before this subcommittee, have introduced legislation that would require a facility oriented fossil energy program at the Department of Energy. This hearing will try to elicit comment on that legislation, as well as industry's problems in commercializing fossil and renewable energy technology, and the need for such facilities.

Mr. **Fuqua**. The subcommittee will be in order.

We begin the first of two hearings on the need for cost-shared energy technology facilities. We will hear from William Vaughan, the Assistant Secretary for Fossil Energy from the Department of Energy, and from Mr. Dwain Spencer of EPRI and Mr. David Webb of the Gas Research Institute, GRI. EPRI, which is the Electric Power Research Institute, and GRI will also discuss technologies other than fossil energy, which will be covered in more detail in the hearing next week.

In the past 3 years Federal energy research and development programs have been reoriented from an emphasis on near-term development, including large scale pilot or demonstration facilities, toward long term, high risk basic and applied research. It has been assumed that private industry would take over the systems testing and demonstration activities previously funded by Federal programs.

It is apparent that the real solution is not as cut and dried as has been assumed. There are several demonstrations of technology at pilot or demonstration levels that continue to receive Federal funding. Many of these, such as fuel cells and the EPRI/TVA atmospheric fluidized bed combustion demonstration, are continued at congressional insistence. Also, some technologies have gone ahead without direct Federal funding during development.

Several Members of Congress, who have already testified before the subcommittee, have introduced legislation that would require a facility oriented fossil energy program at the Department of Energy. This hearing will try to elicit comments on that legislation, as well as industry's problems in commercializing fossil and renewable energy technology, and the need for such facilities.

To begin our hearing today we are very happy to have the Honorable William A. Vaughan, Assistant Secretary for Fossil Energy of the Department of Energy. Bill, we're very happy to have you this morning and would be delighted to hear from you at this time.

Mr. VAUGHAN. Thank you, Mr. Chairman.

Mr. FUQUA. Pardon me just a moment. Also, Mr. Winn, the ranking minority member, wishes to insert a statement in the record immediately following my statement.

[The statement of Mr. Winn follows:]

STATEMENT OF HON. LARRY WINN, JR., ENERGY DEVELOPMENT AND APPLICATIONS SUBCOMMITTEE

Thank you, Mr. Chairman, for this opportunity to make a brief statement. Yesterday in the first of this series of hearings on cost-shared energy technology facilities we heard from several members who have legislative interests in these kinds of programs. We also heard briefly from the Department of Energy and the Synthetic Fuels corporation on the need for pilot or semiworks plants to bridge the gap between proof-of-concept activities and process commercialization.

Today we will discuss this energy aspect with both the Department of Energy and the private sector. Testimony provided by DOE will be very beneficial source material as we evaluate programs containing pilot plant or semiworks plant projects. Both the Electric Power Research Institute and the Gas Research Institute are active in development of energy processes and can speak with authority on the planning, construction and operation of such technology facilities. Information from all these witnesses should be very helpful for making future decisions.

Mr. Chairman, this hearing is timely and important for the consideration of funding requests and for subsequent project and program oversight.

Mr. FUQUA. Pardon me, Bill; please go ahead and proceed.

STATEMENT OF WILLIAM A. VAUGHAN, ASSISTANT SECRETARY FOR FOSSIL ENERGY, U.S. DEPARTMENT OF ENERGY; ACCOMPANIED BY DONALD L. BAUER, PRINCIPAL DEPUTY ASSISTANT SECRETARY FOR FOSSIL ENERGY, U.S. DEPARTMENT OF ENERGY

Mr. VAUGHAN. Mr. Chairman, it is a pleasure to be here this morning. I have with me here at the table my principal Deputy, Mr. Donald Bauer, and I have with me other Program Deputies in the audience. I will freely call on them, with the committee's indulgence, if I feel I need assistance in providing detailed answers.

The formal statement that we have filed is rather lengthy, necessarily so because the committee's charge asked for a lot of detailed information which we tried to supply. What I would like to do at this point is to spend about 5 minutes or so summarizing what I think are the essential features of that lengthy statement.

Mr. FUQUA. We will make the prepared statement, in its entirety, a part of the record, and then you may summarize, and then we'll have the benefit of both of them.

Mr. VAUGHAN. Fine, Mr. Chairman.

Yesterday, the committee heard several references to the issue of semiworks and the Federal Government's involvement in funding this stage of technology development. Eight legislative proposals have been submitted that deal in some manner with projects of this scale, and some of the sponsors of those proposals sit on this very committee.

Let me say at the outset, that the commitment they have expressed by these proposals to the long-term energy security of this country, and to the continued role of coal in assuring that security, is both commendable and worthy of this committee's and Congress' careful consideration.

I have expressed on several occasions, as has my boss, Secretary Hodel, the administration's opinion that a sound and stable R&D program incorporating the talents of both the private and public sectors is fundamentally important to the future of this country.

I believe that the significant efforts of Secretary Hodel and others in bringing our 1985 fossil energy budget closer to the levels recommended by Congress and by this committee is a reflection of this administration's commitment to work with the Congress in fashioning a viable, productive research and development program.

In that regard, Mr. Chairman, we believe one of the most useful functions we in the Fossil Energy Program can perform is to provide you and members of this committee with a technical description of the various technologies that are in the R&D process today, along with our best technical judgment of when, or if, they will require larger scale development beyond the proof of concept stage.

Admittedly, this is an area in which experts can and undoubtedly will disagree, and it will fall to this committee and others to sort out the advice from the evidence it hears.

This is what we have attempted to incorporate in the lengthy statement. Because the various legislative proposals differ somewhat in terms of candidate projects, we have tried in this testimony to be as comprehensive as possible so that we give the committee and staff information across the complete spectrum of fossil energy technologies so that comparisons can be made.

One of the difficulties in labeling stages of development, as I'm sure you recognize, is that the labels often don't translate neatly across technological lines. What is a pilot plant for one technology might be a semiworks for another, or perhaps a demonstration plant for yet a third. It is indeed difficult to provide a uniform definition for various stages of development that holds true widely across the board.

In general, I believe we agree with Chairman Nobel of the Synthetic Fuels Corporation who defined semiworks facilities as being somewhat beyond an initial pilot plant, but somewhat smaller and significantly more shortlived than a commercial plant. But let me point out, in this regard, that I understand why my colleague over at SFC made that definition. He has a set of regulations to guide his funding, and I think he has made that definition in light of those regulations. While I have no disagreement with the definition, I am concerned that there is, in my judgment, some undesirable aspect of focusing too much on these definitions. As I said just a moment ago, what is semiworks in one technology is proof of concept in another.

There also is a tendency to associate some particular or magic size with semiworks, or a dollar amount. I don't think those necessarily follow, either. There are some technologies that may move very rapidly from the proof of concept or even the laboratory right on through to commercial development, with no necessity to go through a semiworks stage; and yet, there are others in which it would be necessary to scale up several times. I think that will have to be determined on an ad hoc basis, and I think this committee, the Congress, and whatever administration is going to have to be flexible in dealing with those kinds of questions on an ad hoc basis.

As I mentioned, Mr. Chairman, the bulk of my formal testimony provides a technology-by-technology status report of development and our best projections of when, or if, a larger scale pilot plant or semiworks might be needed.

As I've stated on page 3 of that testimony, in general, we do not believe that any technology currently in active development is being hindered today because neither the Department nor the SFC are funding construction programs aimed at semiworks or process development.

Let me make two points that flow from that assertion. First, that statement may be challenged by proponents of specific processes. Some second generation coal gasification processes, for example, have not moved into commercial application as rapidly as once envisioned, but others have. For example, the Texaco entrained bed gasifier has moved from pilot plant testing into commercial use at the Eastman Kodak plant with no direct Federal support. The question must therefore be asked, "If it could, why can't others so move without direct Federal funding?" And furthermore, one could ask, "Should the Government play a major role in developing technologies that would compete with the initiatives of private development?"

The second point I want to make is that we have the opportunity today to put into place a sound technological base for future scale up decisions. While there is no question that our energy problems remain real and potentially disruptive, I'm also convinced that serious and costly mistakes can be made by putting into place a large, Government subsidized effort to build demonstration plants or semiworks.

One of the points in providing the detailed technological descriptions, as we have done in our formal statement, is to provide a technical basis for our position that no new technology has run up against a stalemate because of the so-called technology gap.

Many processes are at various stages of development, and given sufficient time—in some cases, 2 or 3 years—we will be at the point where the next logical stage of development may well be a large-scale pilot or so-called semiworks plant. At that point, we believe the developers of these technologies should look at the full scale of financial alternatives, including tax incentives and joint venture financing. If those are not successful, however, as Deputy Secretary Boggs said yesterday, we are prepared to discuss with the industrial developer—as well as with the Congress—ways in which the Government can and should assist.

However, Mr. Chairman, let me reemphasize a point that is made throughout my prepared statement. We believe the private sponsors must be prepared to take some business risks on their own, to assume the initiative—as well as a significant portion of the costs—particularly in the latter stages of development. They should also have the responsibility for determining which technologies make the most commercial sense.

We also believe that it is especially important during these times of budget constraints to recognize that there is no free lunch. The funds appropriated to the Synthetic Fuels Corporation represent real, actual tax dollars. We therefore do not believe that it is in the best interests of the Nation as a whole to transfer a portion of these funds to be spent by the Department of Energy on major construction and demonstration-type projects.

Mr. Chairman, in summary let me say that I believe our end objectives are quite a bit alike. We both want to ensure that new technologies continue to move along the development path, and that the Nation receives the benefit of new energy options.

We therefore want to assist the committee, particularly from a technical standpoint, in determining the proper pace and scope of a Federal research and development program. It is in this spirit that we appear before you this morning.

At this point, Mr. Chairman, I'd be pleased to take your questions or those of your colleagues.

[The prepared statement of Mr. Vaughan follows:]

Statement of William A. Vaughan, Assistant Secretary for Fossil Energy, U.S. Department of Energy

Mr. Chairman and Members of the Committee:

As part of its review of the issue of "semiworks" facilities, the Committee has requested that we provide a summary of the development status for several advanced fossil energy technologies. We are pleased to respond to this request in the following testimony.

Introduction

In 1981, as part of his Economic Recovery Plan, the President announced plans to revamp the federal fossil energy research and development program. Near-term activities, such as construction and operation of pilot and demonstration plants using specific processes, were either concluded or cancelled. Federal support was refocused on more generic, longer-term research projects with higher potential returns to the nation.

In presenting its FY 1982 and subsequent budgets to the Congress, the Energy Department's Office of Fossil Energy depicted the development path for advanced coal, petroleum, oil shale and unconventional gas technologies as having five major stages:

- basic research — involving the development of scientific knowledge;
- applied research — involving broad engineering and physical science aspects of specific energy technologies;
- proof-of-concept — the stage where sufficient knowledge is obtained to establish technical viability and basic engineering feasibility and to permit initial forecasts to be made of a technology's economic and environmental performance.
- process development -- involving increasingly larger scale systems to reduce technical risks and refine process operability, reliability, economics and environmental performance.
- commercialization -- where market-driven decisions are made to deploy full-scale modules or commercial plants employing new technology.

A given technology may require several scale-ups between "proof of concept" and commercial scale. The terms "semiworks" and "pilot plant", therefore, do not always define a specific scale that can be applied across the spectrum of fossil energy technologies. "Semiworks" and "pilot plants" may be the same for some projects; in others they may differ. In general a "semiworks" facility is generally the last step in scaleup to a commercial size plant. We have attempted to make the distinction between "pilot" and "semiworks" facilities where it applies in the following descriptions of specific fossil energy technologies.

The Administration's Fossil Energy R&D Policy

In the last three budget years, the Administration's retargeted fossil energy program has emphasized projects within the basic, applied, and proof of concept stages. The program has moved away from the process development and commercialization stages -- typified by pilot and demonstration plants -- that had dominated previous fossil energy programs.

This change in policy was made to effect a less costly and more focused federal research and development program that would leave commercialization to private energy companies competing in the marketplace. For those first-of-a-kind, commercial-scale projects requiring capital outlays beyond the scope of most firms -- such as large synthetic fuel projects -- the Administration shifted responsibility for commercialization to the Synthetic Fuels Corporation which emphasized loan and price guarantee assistance rather than direct federal cost-sharing.

The Issue of a "Semiworks" Gap

In the area of synthetic fuel technologies, neither the Department of Energy's restructured research and development policy nor the commercialization efforts of the Synthetic Fuels Corporation provide financial support for the "process development" stage of emerging technologies. Similarly, for fossil energy technologies other than synthetic fuels, the private sector was judged to be in the best position to make process development and commercialization decisions.

The Department's position regarding the availability of federal financial assistance to bridge this gap can be expressed as follows:

- First, it is our belief that no specific technology currently in active development is being hindered at the present time because of such a "gap";
- Second, once a technology approaches the "process development" stage, its technical promise and market potential should be sufficiently known so that private sponsors would be prepared to assume the initiative in further development and commercialization efforts.

Recently, six legislative proposals have been introduced in the House of Representatives and two in the Senate that would direct the Department to consider sponsorship of projects in the "process development" (or "semi-works") stage of development. While the general intent of the bills is similar, each contains significant differences in terms of candidate projects, scale of development, and/or source of funding.

Rather than comment specifically on each bill, it may be more useful to provide the Committee with a status report of the development of major fossil energy technologies, along with our best estimates of the necessity, timing, and scale for projects advancing beyond the "proof of concept".

Our discussion indicates where we believe scale up to facilities beyond "proof of concept" may be necessary as an intermediate step towards commercialization; however, as noted above, the Department believes that the final decisions and responsibilities for scale up of emerging technologies should remain a private sector responsibility.

Since "proof of concept" varies (depending on the system or subsystem, its complexity, time to complete the verification, and overall cost to the government), each of the descriptions that follow includes a brief summary of the definition of "proof of concept" as applied to the specific technology. It is important to note, however, that "proof of concept" will differ even within the same technology area depending, in large part, upon the equipment design, the intended market application, and corporate background of the developer. A coal-fired gas turbine, for example, may be able to achieve "proof of concept" for some industrial applications at 1 MWe, while the major utility suppliers would view 100 MWe tests as being "proof of concept."

With this in mind, the following testimony is organized along the major categories contained in the Department's Fossil Energy annual budget request:

COAL LIQUEFACTION

Proof of Concept -- For direct liquefaction, proof of concept would typically entail a facility processing 5-10 tons of coal per day with the capability for determining material balances, liquid yields, product quality, etc.

An indirect liquefaction proof-of-concept unit would incorporate the syngas-to-liquids step at scales of approximately 25-50 barrels of product per day. In both cases, ancillary support equipment, including utilities and gasification systems (for production of hydrogen in direct liquefaction and synthesis gas in indirect liquefaction) would generally not be integrated into the plant.

Direct liquefaction, in which coal is reacted directly with hydrogen, can be described in terms of the following four categories:

1. First Generation, Single Stage Processes (e.g. Bergius)
2. Second Generation, Single Stage Processes (e.g. Exxon Donor Solvent, H-Coal, Solvent Refined Coal I and Solvent Refined Coal II);
3. Integrated Two-Stage Process Concepts; and
4. Advanced Liquefaction Process Concepts.

The first-generation Bergius process was developed in Germany in 1911 and subsequently scaled up and improved by the I.G. Farben industrial conglomerate in the 1920s and 30s. It ultimately was used in 12 wartime German plants to produce about 97,000 barrels per day of synthetic liquids. Because its high operating pressures (in excess of 10,000 pounds per square inch for some bituminous coals) pose severe vessel fabrication problems and result in highly inefficient operation, no first generation direct liquefaction plants have been constructed at commercial scale since World War II, and none are likely to be built.

The EDS and H-Coal direct liquefaction processes have completed successful development through the process development stage. Both were operated for nearly two years at the 200 to 250 ton per day integrated process scale and completed in 1982. (The H-Coal plant is currently mothballed; the Exxon Donor Solvent plant has been demolished.) Conceptual designs have been done for commercial-scale facilities, and the processes are now available for commercial licensing by the developers -- Exxon and HRI, respectively.

The Solvent Refined Coal II and the Solvent Refined Coal I non-integrated two-stage liquefaction process have also been studied extensively both under pilot plant conditions (30-50 tons per day) at Ft. Lewis, Washington, and under test facility operating conditions (6 tons per day) at Wilsonville, Alabama. Results through 1978 showed that both processes were ready for commercial-scale demonstration. At that time both processes were selected for scale-up to commercial-size modules of 6000 tons per day.

Integrated two-stage liquefaction is now in the proof-of-concept stage of development. Testing has been underway since December 1983 at the 6-ton per day liquefaction test facility at Wilsonville, Alabama. Results have shown the process' potential to produce higher liquid yields of higher quality products at lower hydrogen consumption, compared to single stage processes. Testing has been completed using an Illinois #6 bituminous coal, and the concept is now being evaluated using a lower-cost subbituminous coal. Current estimates are that proof-of-concept testing through FY 1985 will be required to complete the engineering data base. At that point, industry will be in a position to make a decision on a pilot-scale facility to reduce technical risks to acceptable levels for commercial consideration. A major reason for this facility would be the scale-up and operability considerations of the interstage deashing system required in the present two-stage concept. Results from the H-Coal and EDS pilot projects strongly suggest that the appropriate size for the next scale up to be a pilot plant in the 200 to 250 ton per day size range.

Several advanced process concepts, including direct coupled staged liquefaction (in which the deashing step is removed between the dissolution and hydrogenation stages) and coprocessing of coal and petroleum residuals, are now in the applied research stage of development involving bench-scale units of 5 to 15 pounds per hour of coal capacity. Both have less than one year of development at this stage. Assuming successful development continues, they would be ready for proof of concept testing at the 5-10 ton per day scale in two to three years.

Indirect liquefaction, in which coal is first gasified and the resultant synthesis gases recombined into liquids, can currently be grouped into four major categories according to the syngas-to-liquids technology employed:

1. Syngas to Fischer-Tropsch liquids -- typified by three commercial plants in operation in South Africa (SASOL);
2. Syngas to methanol -- currently being used by the Tennessee Eastman company in the U.S. and on a smaller scale in South Africa.
3. Syngas to methanol to gasoline -- now being developed in New Zealand in a natural gas to methanol to gasoline plant of commercial scale.
4. Advanced processes for syngas to liquids — represented by DOE's research projects to improve indirect liquefaction processes.

A slurry-phase Fischer-Tropsch concept is currently in DOE's applied research program with activities underway at an integrated bench-scale unit with about one pound per hour of liquid output. When current research is concluded in mid-FY1985, completing four years of study at the bench scale, the feasibility of the chemical process should be known. Proof-of-concept to determine the engineering feasibility would require a larger-scale slurry phase reactor system, although its size has not yet been determined. While not enough engineering information is available at the present time to make a precise judgement, it may be possible to design a proof-of-concept unit that would preclude the need for a pilot plant.

An advanced concept for methanol synthesis, specifically suited for integration with advanced gasifiers without the necessity of intermediate treatment of the synthesis gas, is currently at the proof of concept stage. The "liquid phase methanol synthesis" process is being tested at a 35-barrel per day development unit at LaPorte, Texas, using simulated coal-derived gas prepared from natural gas. The unit was completed about 6 months ago, and while the operation to date has been moderately successful, further test runs will be required before "proof of concept" can be achieved. A pilot operation, perhaps twenty times larger than the La Porte unit would probably be necessary to bring the technical risks to within acceptable levels for commercial decisions. The pilot plant should also integrate the coal gasification step with the syngas-to-liquids step.

A related technology to convert methanol, produced either conventionally or by coal gasification, into high-octane, unleaded gasoline has also been developed. One version of the technology -- the "fixed bed" concept in which catalyst particles remain immobile -- achieved proof of concept at a 4-barrel per day development unit in Paulsboro, New Jersey, and is being scaled up directly to a commercial-scale unit in New Zealand. The more advanced "fluid bed" version -- in which the catalyst particles are vigorously agitated -- has been tested successfully at a 100-135 barrel per day pilot plant in Germany under a joint project between DOE and the Federal Republic of Germany. The plant will be reconfigured to produce olefins from the methanol feedstock which would extend the potential application of the technology to the production of diesel fuel as well as gasoline.

Several projects aimed at developing more selective and more active catalysts and/or improved reactor systems are currently crossing the boundary of basic research and moving into the applied research stage. Both the timing and nature of the proof-of-concept and subsequent testing will depend on the results obtained in the subscale work; however, the more complex the reactor technology is, compared to previously developed systems, the more likely it will require pilot-scale development.

-------------- DOE Position on Liquefaction Semiworks ----------------

Second generation direct liquefaction concepts (EDS, H-Coal, revised SRC-I, SRC-II) have completed pilot plant development. Two of these processes -- EDS and H-Coal -- have been offered for licensing for commercial size plants.

Integrated two-stage direct liquefaction is currently undergoing "proof of concept" scale testing. Once this is completed, a sufficient engineering data base should exist to permit scaleup to a semiworks facility. From a technical standpoint, a decision to scale up this direct liquefaction technology could be made in 2-4 years.

With the completion of "proof of concept" testing of the integrated two-stage liquefaction process at Wilsonville, the private sector should be in a position to make pilot or semiworks scale up decisions. In making these decisions, one factor likely to be considered is the possibility that concepts at earlier stages of research could offer further improvements as they mature into more advanced stages of development. These concepts could include directly coupled staged liquefaction processes or coprocessing techniques, both of which are currently in the applied research stage. Considering the potential need of pilot plant work for these advanced direct liquefaction processes, a decision for scaleup to a semiworks plant is likely to be 6-10 years away.

For syngas to Fischer-Tropsch liquids or methanol, scale up to semiworks may not be necessary on the basis of existing commercial plants in the U.S. and other countries.

Syngas-to-methanol-to-gasoline projects in New Zealand and the Federal Republic of Germany will provide adequate knowledge for either coal-based or natural gas-based conversion of fossil fuels to gasoline; therefore, semiworks facilities will not be required.

For DOE's advanced indirect liquefaction programs, initial "proof of concept" testing of the La Porte liquid phase methanol synthesis unit has only recently begun. A decision on an integrated pilot plant, therefore, is perhaps one to two years away. A semiworks scaleup decision is not appropriate before pilot plant studies are completed.

SURFACE COAL GASIFICATION

Proof of Concept -- typically involves a facility operating in a continuous mode at a scale of 1 to 30 tons/day although such ancillary operations as oxygen separation plants or downstream processing devices, such as shift or methanation units, are rarely integrated into the facility.

Full-scale gasification systems exist and are operating on a worldwide basis. A survey of these systems has shown that more than 300 individual gasifiers, representing seven different manufacturers, are currently operating around the world. Their principal uses are to produce:

	Number of Gasifiers
1. low-Btu gas for industrial uses/power gen......	115
2. medium-Btu gas for town gas application........	70
3. medium-Btu gas for combined cycle	2
4. synthesis gas for ammonia production...........	53
5. synthesis gas for methanol production..........	6
6. synthesis gas for hydrogen production..........	6
7. synthesis gas for indirect liquefaction hydrocarbon production.........................	53

Most of these gasifiers are "first generation," non-U.S. technologies. Several would not be acceptable either from a cost or environmental performance perspective in this country. Within the U.S., however, four commercial-scale gasifier concepts have been introduced on a commercial scale:

- o 14 1000-ton per day Lurgi fixed bed gasifiers at the Great Plains Coal Gasification Plant are under construction in North Dakota. Three gasifiers have now been operated; the first train of seven gasifiers is scheduled for first integrated operation in July; both trains (7 gasifiers in each train) are expected to be in operation by the end of December;
- o Four 900-1000 ton per day Texaco entrained bed gasifiers, two of which are in operation at the Tennessee Eastman coal-to-chemicals facility in Kingsport, Tenn., and two are in startup at the Cool Water gasification-combined cycle plant at Daggett, California;

- o A 600-ton per day KilnGas horizontal rotating gasifier now in the demonstration stage at the Wood-River Power Station near East Alton, Illinois;
- o An 800-ton per day Dowsyn entrained bed gasifier now in operation at Dow Chemical's demonstration unit in Louisiana.

In the last 25 years significant amounts of time and money have been directed to the development of advanced gasifiers by the Government as well as by the private sector (the latter is exemplified by the Texaco, Kilngas, and Dowsyn gasifiers referenced above). These efforts have resulted in significant advances in gasifier technology. At least eight concepts have advanced through the proof-of-concept development stage and are logical candidates for subsequent commercialization. Among those that have evolved specifically from the federal research and development program are:

- -- Agglomerating Pressurized Fluidized Bed (Westinghouse)
- -- Agglomerating Fluidized Bed (IGT U-Gas)
- -- Hygas (IGT)
- -- CO2 Acceptor
- -- Catalytic Coal Gasification (Exxon)

Two of these gasifiers (Westinghouse and U-Gas) have been incorporated in commercial-scale projects submitted to the Synthetic Fuels Corporation. Another gasifier, the British Gas Corporation's slagging Lurgi gasifier, which was a part of the federal program in the past, has now reached technical maturity with a 300-ton per day unit operating and a larger unit now under construction.

Therefore, the Department's R&D efforts are now focused on acquiring an improved understanding of the gasification process itself and extending the capabilities of the technology so that a slate of products can be produced that is fully responsive to changing market demands and advances in utilization technologies.

In addition to improving the gasification process itself, opportunities exist for increasing the effectiveness of several gasification subsystems, i.e. coal feeders, controls, materials, and downstream processing processes and components. DOE is involved in the improvement of these systems at the benchscale. As these concepts are further developed, they will require testing at the proof-of-concept stage.

------------- DOE Position on Surface Gasification Semiworks ----------

Several gasifiers and gasification processes have moved through the pilot, or "semiworks" stage of development and are now available for commercial scaleup and use. In some cases, the gasifiers originated in the federal research program; in others the private sector provided the principal development initiative. Several of these advanced gasifiers and processes have passed the strength and maturity tests of the Synthetic Fuels Corporation.

Our position is that the Department of Energy has a more appropriate role to advance the state-of-the-art through parallel development of new concepts, generation of data bases for risk assessments, improvement of environmental acceptability, and development of process configurations that can produce a variety of products from a range of coals.

UNDERGROUND COAL GASIFICATION

Proof of Concept -- When applied to underground coal gasification, proof of concept is a broader term than when applied to other, hardware-intensive technologies. The terms "benchscale", "pilot plant," etc., have little relevance in underground coal gasification. Instead, proof of concept involves the combining of such capabilities as site characterization, process control, well linkage, etc., into a field test of a single, commercial-sized module. Field testing is essential for "proof of concept" because the technological uncertainties are typically associated with geophysics and geochemistry, both of which are exceedingly difficult to simulate in small-scale, laboratory tests. Such a test is also important to verify environmentally acceptable impacts from retort abandonment.

The "pilot" or "semiworks" scale for underground coal gasification must encompass the simultaneous operation of several commercial-scale modules gasifying 100 to 300 tons of coal per day and time sequenced over 3 to 4 months to provide a steady flow of gas with uniform composition. Inherent in the "semiworks" scale would be at least one relay of the gasification from a set of modules to the next, plus operation of gas processing or cleanup systems deemed unique to underground coal gasification product gas.

Underground coal gasification to date has been operated at commercial scale only in the Soviet Union. No valid economic or process data is available from the Soviet operation.

In the U.S., proof of concept has essentially been achieved for the underground gasification of steeply-dipping (greater than 60 degrees), subbituminous coal beds. As much as 100 tons per day of coal has been gasified in test runs of more than two months.

Several large-scale tests of flat-lying, subbituminous coals have been conducted, but a "proof of concept" test has not been conducted that incorporates all of the major variables, particularly parallel row operation and the relaying of a burn zone across a coal field. Such a test (or tests) could be conducted either in the U.S. or abroad later this decade.

Underground gasification of bituminous coals is still in the early stages of development and will need additional research into the areas of drilling, linking, maintenance of flow channels in swelling coals, and operation in thin seams. DOE's underground gasification program has not, as yet, addressed anthracite or lignite as potential target resources for this technology. These could be targets of opportunity for research in the future.

----------- DOE Position on Underground Gasification Semiworks ----------

Pilot or "semiworks" as applied to underground coal gasification typically would involve multiple rows of commercial-scale test burns. The modular nature of underground coal gasification means that no intermediate level demonstration would be required for commercial applications once successful operation at the "proof of concept" level and multiple module "pilot" operation has been achieved.

FLUIDIZED BED COAL COMBUSTION

Proof of Concept -- For atmospheric fluidized bed combustors, proof of concept entails testing at unit sizes of approximately 500 to 1500 pounds per hour of steam output with tests conducted over a 1 and 1/2 year duration to generate sufficient data on such factors as materials handling, bed dynamics, heat exchanger design and life. For pressurized fluidized bed systems, because of their principal application in electric utilities, proof of concept would consist of a facility capable of generating 10 to 25 megawatts of electricity (equivalent to 100,000 to 250,000 pounds per hour of steam).

Currently 18 U.S. boiler manufacturers offer first generation industrial atmospheric fluidized bed (AFB) units on a commercial basis. Approximately 70 such units have been installed and operated in the U.S.; 30 are designed to burn coal. First generation AFB technology is considered commercial for large industrial boiler applications of 200,000 pounds per hour of steam or greater; however, significant opportunities exist for improving performance and reliability and for expanding the technology into both the smaller-scale industrial boiler markets and the much larger utility boiler applications.

Second generation AFB technology is still in the applied research stage of development. Conceptual studies for several advanced AFB units were completed in March 1983. The Department plans to move the most promising techniques into "proof of concept" testing in the latter part of FY 1985. This stage of development would be at approximately 500-1500 pounds steam per hour, with tests conducted over a 1 and 1/2 year duration. A subsequent pilot plant unit of approximately 10,000 pounds of steam per hour -- would probably be necessary before second generation AFB technology could be introduced commercially; however, no large demonstration or semiworks plant is believed to be necessary if all technical milestones are achieved.

AFB technology also holds potential for the utility sector, both for new facilities as well as repowering oil/gas-fired units and conventional coal-fired units that must be retired. Utility versions of AFB technology have also progressed through the "proof of concept" stage. To achieve the goal of making commercial scale utility application possible this decade, the Tennessee Valley Authority, in conjunction with the Electric Power Research Institute, has taken the lead in constructing and operating a 20 MWe pilot plant at the Shawnee Power Station near Paducah, Kentucky. The facility has been in operation for more than two years.

The next stage of development — commercial demonstration -- is now underway with three complementary utility projects proceeding under private sector leadership. In one project, TVA has joined with EPRI, Duke Power, the State of Kentucky, and the Peabody Company (with other partners being sought) to build a 160 MWe new AFB boiler at Paducah. The Department of Energy will provide $30 million in FY 1985 and 1986 for this project, which is planned for operation in 1989.

Two companion projects are in earlier phases of planning. One of the projects, with Northern States Power as the lead company, would convert an existing 100 MWe pulverized coal boiler to an AFB system, increasing its capacity and adding perhaps as much as 25 years to the expected plant life. The demonstration would be built and operated as a commercial venture. Operations are expected to begin in 1986.

Another AFB application is being examined by the Colorado-Ute Electric Association. Studies are underway to determine the feasibility of adding a new 110 MWe "circulating" fluidized bed boiler (as contrasted to the "bubbling" bed designs of the TVA and Northern States projects) to repower an existing 40 MWe steam turbine/generator as well as drive a new 70 MWe steam turbine/generator. The AFB concept reflects a European design for the base of the boiler, but is being offered by U.S. manufacturers.

As Kurt E. Yeager, Vice President of the Coal Combustion Systems Division for the Electric Power Research Institute, testified before this Committee on March 6, 1984, "The continuity and success of the previous combined Federal/private development effort is making these pioneer AFB demonstrations possible primarily through private support. This provides a successful prototype for similar utility and government collaboration in other areas of coal utilization R&D."

Pressurized Fluidized Bed (PFB) technology could also be used to replace retiring coal-fired steam units, or in new plants required for demand growth, or for repowering oil and gas-fired steam units.

As a result of approximately a decade of federally funded research, PFB technology is now considered to be in the "proof of concept" stage of development; that is, plants have been built and/or operated in the 13 to 25 MWe range. The IEA-Grimethorpe facility has a power rating of 25 MWe and has operated successfully since 1982. A 13 MWe PFB pilot plant in Wood-Ridge, New Jersey, has been constructed but has not been operated.

The conservative nature of the utility industry will likely require a large-scale unit (75 to 125 MWe or sufficient to match available utility scale turbines) be operated satisfactorily before the technology would be accepted for commercial application; however, before such a plant could be constructed, major technical uncertainties must be resolved. These include a) hot gas cleanup for gas turbine protection; b) materials survivability for the heat exchange, gas turbine, and solids handling equipment; and c) solids handling improvement in feeding, distribution, and bed removal.

------- DOE Position on Fluidized Bed Combustion Semiworks -----

In the industrial sector, fluidized bed technology is commercially developed at scales of 200,000 pounds per hour of steam. DOE's research program is seeking to develop technologies that are economically viable at smaller sizes or which can be adapted to specialized applications. For these smaller size applications, "proof of concept" will be sufficient to enable commercial decisions to be made.

For the utility scale AFB technology, projects are underway with private sector leadership that should establish the viability of the concept. DOE is participating financially in one of the ongoing projects. No further federal involvement is deemed necessary.

For PFB technology, "proof of concept" testing would be completed by 1986 and a larger scale utility demonstration effort will probably be required. Several technical issues exist, however, which can be resolved more cost-effectively at smaller scales. If these technical uncertainties can be resolved and PFB technology is judged to be a viable utility option, we would expect the private sector to assume the initiative in subsequent scaleup.

ADVANCED COMBUSTOR TECHNOLOGY

Proof of Concept would consist of a long-term durability test of a unit sized at approximately 50 million Btu/hour, plus confirmation of environmental capabilities.

The Department of Energy is developing an advanced coal-fired combustor capable of being retrofitted onto an existing oil- or gas-fired unit. Inherent in the combustor's design would be the capability of removing ash (in the form of slag) to prevent boiler tube fouling. This design feature is also expected to provide improved environmental performance over conventional coal-fired combustors.

Projects within the Department's program range from basic research efforts for an innovative concept to proof-of-concept testing for more technologically mature concepts. These projects have been receiving Government support for less than one year, although partial development work on two of the concepts originated through the DOE-supported MHD program and through private sector development.

The combustor development projects currently in the proof of concept phase will be completed in 1986 with tests of two 50 million Btu per hour (industrial size) combustor integrated with a furnace simulator. In addition, two firms (Rocketdyne and Coal Tech Corporation) have privately financed efforts underway to develop and test a slag-rejecting combustor.

There are also five innovative combustor concepts being studied by DOE. These concepts range in application from utility through the residential sectors. The most promising of these will be selected for further testing in FY 1986. At that time each application should be mature enough for the private sector to assess whether a semiworks plant is necessary.

--------- DOE Position on Advanced Slagging Combustor Semiworks --------

No semiworks plant is considered necessary. The Department's research program, in addition to efforts underway in the private sector, should establish the technical and commercial viability of this concept by 1986.

COAL SLURRY COMBUSTION

Proof of Concept -- entails a detailed combustion and component characterization for selected systems and varies depending upon the specific application. In most cases, a field test is required to determine system performance, technical applicability, economic feasibility, environmental performance, and logistic practicality.

A discussion of coal-liquid mixture combustion technology must be focused on specific applications:

- Coal-water mixtures for Utility/Large Industrial Boilers
- Coal-liquid mixtures for Institutional/Commercial/Residential boilers and furnaces
- Coal-liquid mixtures for Turbines/Diesels

Based on a cooperative federal-private development effort begun in 1979, the technology for applying coal-water mixtures in utility/industrial boilers has now reached the "proof of concept" stage. Federally funded research is scheduled for completion in FY 1985.

Coal-liquid mixture technology for institutional/commercial/residential applications is still in the applied research stage with efforts centering on defining specific system configurations and component development requirements and developing preliminary fuel specifications. Assuming all program milestones are achieved, the technology will complete the proof of concept stage around the 1990 timeframe.

Coal-liquid mixtures for gas turbines and diesel engines are also at the applied research stage with the majority of test efforts focused on individual components, rather than a total system. This technology should also complete the "proof of concept" stage of development in mid-CY 1989.

--------- DOE Position on Coal Slurry Combustion Semiworks --------

With the present private sector momentum and the Synthetic Fuels Corporation coal-water mixture solitication for utility/large industrial applications, it is believed that an intermediate or semiworks stage will not be necessary for commercialization in this market application.

A semiworks stage will likely be required prior to commercial acceptance of coal-liquid slurries for residential/commerical/institutional applications. The approximate size of the systems would range from 100,000 Btu/hour (home heating) to 50 million Btu/hour (institutional applications). Decisions on such facilities, however, should not be made until the technology has approached or achieved the proof of concept stage later in this decade.

A semiworks stage will also be required prior to commercial acceptance of coal slurries applied in gas turbines and diesel engines. Such systems would be sized in the 5 to 50 MWe (500 to 1000 horsepower for diesels) range. Several more years of technology development will be required, however, before a semiworks facility should be considered for these applications.

COAL PREPARATION

Proof of Concept — Physical coal preparation will likely require a contінously operating system capable of processing 1-3 tons per hour of coal. Chemical coal preparation "proof of concept" units will be smaller, with a nominal continous processing rate of 200-2000 pounds per hour.

The commercial practice of conventional coal cleaning is common and widespread. This technology, however, is limited to gravity separation and froth flotation processes. Conventional physical cleaning extracts only the coarser forms of mineral matter, including pyritic sulfur. None of the organic sulfur chemically bound in coal is removed. More than 500 commercial coal preparation plants are operating in the U.S. Approximately 35 percent of U.S. steam coal (more than 240 million tons/year) is physically cleaned.

DOE's physical cleaning program is attempting to enhance physical separation of ash and pyritic sulfur at fine and ultrafine coal sizes. Two general technologies are being pursued: true-heavy-liquid cyclones, and selective coalescence. Both are in the applied research stage of technology development with projects conducted at the laboratory or bench scale.

Both the true-heavy-liquid cyclone and selective coalescence technologies should move into the "proof of concept" stage in the 1986-88 timeframe with testing at a scale of 1-3 tons per hour. These tests (or others to be proposed by industry in response to a forthcoming DOE request for proposals) would be conducted at the Electric Power Research Institute's Coal Cleaning Test Facility in Homer City, Pennsylvania.

DOE's chemical cleaning program consists of three elements: fused salt alkali displacement (TRW Gravimelt), microwave alkali displacement, and microbial desulfurization. Each of these are also in the applied research stage of technology development. A 20-pound per hour continuously operating unit is under construction for the fused salt process and operations should begin in about a year.

If all technical milestones are achieved, the fused salt and microwave processing techniques should achieve "proof of concept" at unit scales of 200 to 2000 pounds per hour by 1987-89.

---------- DOE Position on Coal Preparation Semiworks ----------

For advanced physical cleaning technologies, successful operation at the 1-3 ton per hour scales planned for the Homer City cooperative project with EPRI should provide adequate demonstration for private industry to proceed to commercialization. The primary reason for this belief is the modularity of coal preparation plants; a successful test at 1-3 tons per hour could be scaled to a commercial module which would then be replicated in a commercial plant.

Because of the higher risk and lack of existing market infreastructure for chemically cleaned coal, a pilot or semiworks unit beyond the "proof of concept" scale may be required prior to industrial commercialization. While the Department is currently planning to begin a conceptual design of a 500-pound per hour (6 ton/day) "proof of concept" unit, such a plant should not be built until additional data is obtained at the 20 pound/hour scale.

FLUE GAS CLEANUP

Proof of Concept -- entails a minimum of a six-month testing on boiler slip streams of 10,000 to 20,000 standard cubic feet per minute (5-10 MWe). Full scale scrubber modules are generally on the order of 100 to 150 MWe.

As of June 1983, 114 flue gas desulfurization units were operating in the U.S., with 27 additional units under construction. More than 40,000 megawatts are currently being produced by plants equipped with scrubbers. Approximately 85 percent of the scrubbers operating today in the U.S. are the "wet scrubber" variety. At least 24 spray drying units have been sold to industries and utilities in sizes of up to 860 MWe. Seven boilers are equipped with advanced regenerable Wellman-Lord scrubbers (operating in the 60 to 500 MWe range) and three are equipped with Magnesium Oxide scrubbers (in the 160 to 300 MWe range).

DOE's ongoing research program to develop advanced scrubber concepts is currently in the applied research and proof of concept stages of the development path. Several innovative scrubber concepts are in laboratory or benchscale testing. Two concepts — both of which use electron beams to ionize sulfur and nitrogen oxide pollutants, permitting them to react chemically with scrubbing reagents — have now progressed to proof of concept testing facilities of 10,000 scf/m (Research-Cottrell lime spray dryer unit at TVA's Shawnee power station) and 15,000 scf/m (Ebara ammonia-injection spray dryer unit under construction at an Indianapolis Power and Light plant). These units are equivalent to 5 MWe and 7 MWe, respectively. The completion of the proof of concept testing phase for these processes should occur between 1985 and 1990.

Another, DOE-developed flue gas cleanup concept, the copper oxide fluid bed concept, will move into the proof of concept development stage with the issuance of a request for proposals in FY 1985. A key factor to be resolved, however, before this technology can be considered viable for commercial application is the rate of attrition of the catalyst. The planned proof of concept unit would be equivalent to approximately 5 MWe in size.

The Department has also proposed, in conjunction with its FY 1985 budget request, to begin a new effort to develop a modest performance, inexpensive retrofit scrubber. This effort, which is to be initiated in response to the President's expanded acid rain research program, would also be sized in the 1 to 5 MWe range.

------------ DOE Position on Flue Gas Cleanup Semiworks ----------

Current DOE funded cleanup technologies are being tested at bench or proof-of-concept scale. A full-scale demonstration on the order of 100 to 125 MWe will likely be necessary to convince utilities to invest in commercial-size units.

GAS STREAM CLEANUP

Proof of Concept -- Since gas stream cleanup technologies can be applied to a broad spectrum of processes, e.g. gasification, pressurized fluidized bed, direct fired gas turbines, fuel cells, etc., the facilities required for proof of concept vary greatly and, in some cases, must still be determined. In general, however, a proof of concept cleanup train would consist of sulfur, alkali, particulate and possibly a hydrocarbon control system. For a pressurized fluidized bed system, such a "total contaminant" system integration would be sized at approximately 10,000 cubic feet per minute (or roughly equivalent to the Grimethorpe pilot facility scale).

Current technology for cleaning the gas stream of coal gasifiers or advanced combustors operate at much lower temperatures and pressures than the technologies being developed in the DOE program. The advanced systems under development operate in excess of 1600 degrees F and 10 atmospheres of pressure.

Because of the multiple technology applications, there are several gas stream cleanup concepts at various stages of development. For the most part, the approaches being investigated fall into the applied research area, however, some work is being conducted in the more basic research areas involving gas flow properties and contaminant characterization.

The applied research efforts are generally conducted at scales of 0.2 to 2.5 pounds per second, while basic research efforts may be as small as 0.05 to 0.2 pounds per second gas flow.

If all program milestones are achieved, proof of concept for upstream cleanup techniques for pressurized fluidized bed and gasification/turbine combined cycles would be achieved by the end of calendar year 1988. This would involve the development of alkali and particulate control to permit conventional gas or expander turbine operation with pressurized fluidized bed combustors and the development of sulfur and nitrogen oxide, hot fuel gas stream control to provide for less costly gasification combined cycle emission control.

The development of an effective sorbent system to reduce hydrogen sulfide and to control soot contamination in a molten carbonate fuel cell power system is scheduled to be completed in mid calendar year 1987.

By 1988, plans are to develop process modification contaminant control techniques for acid rain precursor control applied to conventional combustors. By 1990, DOE plans to develop process modification contaminant control techniques for advanced combustors (PFB combustors) and gasifiers.

----------- DOE Position on Gas Stream Cleanup Semiworks ----------

Since the gas stream cleanup program is multi-technology oriented, each concept will likely follow its own distinct technological development path and require different pilot and demonstration efforts prior to commercialization. Because certain critical factors depend upon flow distribution and scale, in most cases, a pilot step of roughly 10,000 cubic feet of gas flow per minute will be required, and in some instances, a larger scale demonstration effort sized at 40,000 to 50,000 cubic feet per minute will be necessary. These efforts, in most cases, would be incorporated into an existing facility or be a part of a total "semiworks" system involving advanced combustion/conversion or end-use equipment.

HEAT ENGINES

Proof of Concept -- Successful operation of a "test bed" gas turbine engine in the 1-10 MWe scale would be necessary to achieve "proof of concept" for advanced gas turbines firing minimally-cleaned coal or coal-derived fuels and applied to the industrial or transportation markets. Utility prototype engines would probably be sized at up to 100 MWe. For a coal-fired diesel engine, the size would be in the 500-1000 horsepower range. In both cases, "proof of concept" fits logically between static test verification (of fuel, design, and operating specifications) and true commercial prototype tests.

The startup in May 1984 of the Cool Water Coal Gasification Combined Cycle Demonstration Power Plant in Daggett, California, marked the first commercial-scale application of coal gasification integrated with a gas turbine for power generation in the U.S. It should be noted, however, that the gas turbines that make up the 100 MWe Cool Water facility, along with several industrial gas turbines, are designed to operate on highly purified coal-derived gaseous fuels.

The DOE research program, on the other hand, is developing gas turbine technology capable of being fired with coal slurries, dry coal, or minimally cleaned (consistent with environmental requirements) coal-derived gas.

The technology for coal-fired gas turbines has progressed from the basic research efforts begun in 1982 to the earliest stages of applied research. If all technical milestones are achieve, the program should move into the "proof of concept" stage in the 1987-88 time period. Current planning calls for this stage to incorporate a test bed engine in the 1-10 MW size range. Assuming successful operation of this device, the proof of concept stage should be completed by 1990-91, at which point the private sector should be in a position to determine the size of a commercial prototype. Depending upon the application, this prototype could be sized in the 5-50 MWe range.

The coal fired diesel program is expected to follow approximately the same development schedule. Having begun in 1982, the federal program is scheduled to culminate with a "proof of concept" test in the 500-1000 horsepower range beginning in the 1987-88 time period and extending into 1990-91. The private sector would also determine the size of this commercial prototype based on the intended market segment. The size will probably fall in the range of 100 to 5000 horsepower, again depending upon the application.

------------- DOE Position on Heat Engine Semiworks ------------

A prototype engine test demonstration will likely be required by the private sector before either a coal-fired gas turbine or diesel engine can be commercialization. In both instances, the "proof of concept" tests should provide a convincing basis for subsequent private sector prototype testing. Several technical uncertainties remain, however, that must be resolved before such a demonstration can be undertaken. The likely timeframe for decisions regarding such prototypes is not before 1987-88.

FUEL CELLS

Proof of Concept -- varies among the different fuel cell concepts and among the differences in application. Proof of concept for the phosphoric acid fuel cell applied to utility power generation would involve the successful operation of fuel cell stacks of up to 700 kW each. These stacks could be integrated into commercial size modules of up to 11 MW. For onsite applications, a proof of concept unit would be comprised of single stacks sized at up to 400 kW output.

The molten carbonate fuel cell for electric utilities will reach the proof of concept stage when stacks with a power output on the order of 1 MW can be successfully operated. Onsite applications of molten carbonate technology would be sized on the order of 100 kW for a proof-of-concept test.

The solid oxide fuel cell, which has a significantly different design configuration than the phosphoric acid and molten carbonate technologies, is at such an early development stage, it is not yet possible to determine an adequate proof of concept scale.

The fuel cell program is made up of three distinct technological groupings: the phosphoric acid fuel cell, the molten carbonate fuel cell, and the solid oxide fuel cell.

In the phosphoric acid fuel cell program, two 4.8 MW electric utility prototype powerplants have been constructed. One is operating while the other has experienced significant startup difficulties. These units have provided sufficient information for engineers to refine estimates of the scale and timeframe required for achieving "proof of concept" for the phosphoric acid fuel cell technology. DOE is currently participating in cost-shared projects with manufacturers that are intended to achieve this level of development. The goal is to achieve "proof of concept" through the development and operation of fuel cell stacks of up to 700 kW each that can be used as the design basis for an electric utility power plant of up to 11 MW. This effort is expected to be completed by December 1986.

Another application for phosphoric acid fuel cells is for onsite power and heat (steam) generation. Forty six 40 kW preprototype powerplants are now being delivered in a joint federal-industry field test. Optimum scales for future onsite units will likely be up to 400 kW output.

The molten carbonate fuel cell is in the applied research stage of development. Short fuel cell stacks roughly 1/10th the height and cell area of those anticipated for utility powerplants have been operated in laboratories, but lifetimes must be extended by 10 to 20 times. DOE's molten carbonate fuel cell program would begin the proof-of-concept stage of development by the end of 1987, if the technical goals can be achieved.

The solid oxide fuel cell is in an earlier stage of development. Several single cells and a three cell unit have demonstrated stable laboratory operation for several thousand hours. Like the molten carbonate cell, the solid oxide fuel cell would enter the proof-of-concept stage in the latter part of 1987 if development remains on schedule.

---------- DOE Position on Fuel Cell Semiworks ----------

The modular nature of fuel cell development is expected to bring the risks of fabricating large-scale commercial units within the limits of the private sector once "proof of concept" is achieved. Ongoing development activities within the Department's phosphoric acid fuel cell program have been structured to lead to a full-scale demonstration effort by the private participants once a sufficient data base is developed. Several technical uncertainties must be resolved in the molten carbonate and solid oxide program before intermediate development stages can be defined.

MAGNETOHYDRODYNAMICS

Proof of Concept — entails the performance and durability testing, for several hundred hours, of integrated topping cycle components at a scale of approximately 50 MW (thermal) and of integrated bottoming cycle components at a scale of approximately 25 MW (thermal)

Following nearly a decade of public and private research and development, the magnetohydrodynamics (MHD) program has reached a point where the various components that make up the power train are at differing stages of technical maturity. In its FY 1985 budget request, the Department proposed to undertake a focused program to bring these individual components to common levels of technological development through both research efforts and integrated testing. A series of public meetings has been held to define better the scope and timeframes associated with this effort.

Testing of major MHD components and subsystems has been underway at two major facilities for about three years — the 50 MW (thermal) Component Development and Integration Facility near Butte, Montana, and the 28 MW (thermal) Coal Fired Flow Facility at Tullahoma, Tennessee. The Butte facility integrates the "topping cycle" of an MHD system, i.e., the combustor, nozzle, channel, diffuser, magnet, and inverter. These components have been operated in an integrated mode for short durations to date.

The Tullahoma facility tests the "bottoming cycle" components, i.e., the heat and seed recovery system and the particulate collection system. Each has been tested separately to date.

Two to three more years of further component and subsystem development at these facilities is required to complete the proof-of-concept stage. The goal will be to operate these components for long durations, extending several hundred hours.

------------ DOE Position on MHD Semiworks Facility ------------

An integrated development system, possibly a retrofit to an existing power plant in which the DC power output from the MHD topping cycle is about 50 MWe and the total power output is about 100 MWe (total energy input to the plant would be about 250 MW thermal), will probably be necessary before the technology can be commercialized. The Department has conducted an initial series of meetings with the MHD research, manufacturers, and users community to determine the most appropriate and cost effective program to continue development of MHD. Recommendations are being prepared for transmittal to Congress.

ENHANCED OIL RECOVERY

Proof of Concept must be regarded in a different context for enhanced oil recovery (EOR) relative to other technologies that are governed largely by the sizes of hardware. For EOR, proof of concept would be attained when, upon fluid injection into a sufficient breadth of reservoirs, it has been established with relative certainty that an oil bank has formed and has been observed to move in a stable manner to producing wells. The test would be done in the field and would last from 1-5 years depending upon well spacing and other variables.

Enhanced oil recovery today accounts for just over 5 percent of the total U.S. oil production -- or about 461,000 barrels per day. The technology in predominant use is thermal recovery, comprising 80 percent of total EOR production although only 4.3 percent of total U.S. production. Miscible gas flooding accounts for less than 1 percent of oil production, while chemical methods -- principally polymer flooding -- comprise only 0.1 percent of total U.S. production. In nearly all cases, EOR production comes from reservoirs that are more easily understood and are amenable to existing techniques.

It is difficult to generalize about the stage of development of enhanced oil recovery technology. It varies from method to method.

Thermal methods are obviously commercial, but certain aspects of steam flooding such as "mobility control steam floods with foams" are in the proof of concept stage (and some work is also being done in the laboratory at the basic stage of research). In situ combustion has also been commercial in certain, very favorable settings, but there have been more failures than successes.

Chemical flooding is comprised of micellar-polymer, polymer, and caustic flooding techniques. Polymer flooding can be considered commercial; however, the techniques are relatively inefficient. Micellar-polymer and caustic flooding are at various stages of development from basic research to proof of concept.

Miscible gas flooding (carbon dioxide), much like steam flooding, is hard to characterize because while there are several commercial projects in the most favorable reservoirs, there is also significant basic research underway to improve the effectiveness of the process.

For tar sands, "first generation" mining plus surface processing is technologically commercial. In situ technologies and advanced surface-based processes, such as fluid bed heating/coking are still in earlier stages of research and have not yet reached "proof of concept."

In general, there has been a renewed effort toward more basic research in EOR development, primarily due to the realization that progress has been slow and complexities have been larger than anticipated. Research continues to be done by both private companies and the government, the latter focusing on fundamental issues which are insufficiently support by industry.

------------- DOE Position on EOR Pilot Projects ---------------

Because of the distinctions between EOR technology and hardware-based energy processes, the term "semiworks" has little relevance. Pilot projects (field tests), however, are prerequisites before designing a commercial EOR project, and sometimes more than one pilot project is necessary in the same reservoir for optimum design or for the determination of alternate methods. The sporadic success of past field experiments — both publicly and privately sponsored — have reinforced the need to focus a significant development effort on more basic research to improve the fundamental understanding of EOR technologies. This is necessary to improve future predictability and effectiveness of EOR. The Federal program, therefore, has focused its efforts on this more fundamental research effort.

OIL SHALE

Proof of Concept -- For aboveground retorting of oil shale, proof-of-concept projects vary considerably in size. In general, the scale should be of sufficient size to test the major engineering behavior of the entire shale conversion system (not just the retort itself). In several cases, hardware has been sized at approximately 1-ton per hour (24-tons per day). In situ technologies require field testing that is scaled commensurate with the particular technology and which provides sufficient knowledge to determine the environmental impacts of retort abandonment.

One aboveground oil shale retorting technology — developed by Union Oil — is presently in the startup phase for commercial operation. The project is comprised of the first 10,000 barrel per day module of a commercial plant that ultimately could be sized at 50,000-100,000 barrels per day.

In situ technologies have also been developed. One (a modified in situ process proposed by Occidental/Tenneco) is in the initial construction stages awaiting SFC loan and price guarantee assistance, while a second (a true in situ project proposed by Geokinetics) is also awaiting final SFC assistance. In general, a large number of in-situ "commercial-scale" retorts will be required to equal the daily production of a single continuous-throughput surface retort module because of the batch operation of the in situ process.

Public and private efforts to improve retorting technologies as well as to develop new concepts encompass the full range of research and development, from basic laboratory research (for example, Gulf Oil's research on donor research on donor solvent technology) to the startup of a 350-ton per day pilot plant (by Chevron for their fluidized bed retorting process). Additionally, most of the "first generation" processes considered ready for commercial testing are still undergoing process improvement testing.

DOE's research program includes a limited amount of small-scale testing of advanced retorting concepts. For example, Lawrence Livermore National Laboratory is testing a cascading bed retorting concept, and the Morgantown Energy Technology Center is examining a twin fluidized bed approach.

DOE Position on Oil Shale Semiworks

Several oil shale retorting concepts have moved through the early stages of research and development, and in some cases, have attained the "proof of concept" stage. Private industry has assumed the initiative in constructing semiworks facilities for several of these concepts, i.e. the 24 ton per day Lurgi pilot plant constructed in conjunction with the Rio Blanco project and the 350 ton per day Chevron unit. The factor limiting further investments today in oil shale technology is the price of world oil and high capital costs of facilities. Federal research has been focused, therefore, on establishing a firm technological data base from which new, more cost-effective technologies could be developed, including concepts that are applicable to lower grade shales.

UNCONVENTIONAL GAS RECOVERY

Proof of Concept -- For the Western Gas Sands program, proof of concept entails developing the necessary technologies and strategies for producing gas economically from lenticular tight sand formations. For the Devonian Shale program, it means developing the technologies for economically producing gas from areas where production potential has been indicated but as of yet there is no established production. In both cases, the "proof of concept" stage must be conducted in the field (because of the impracticality of simulating in situ conditions in the laboratory) and in a sufficient number of reservoir types to prove that the technology is generally effective in extracting gas.

"Proof of Concept" for gas hydrates and deep source gas activities is two-fold. First, it must be established that there is a gas resource present that warrants development expenditures. Second, in the gas of gas hydrates, extraction techniques must be demonstrated to be effective, and for deep source gas, new areas for gas exploration must be determined.

Like enhanced oil recovery, traditional definitions for the stages of development lose some degree of relevance when applied to unconventional gas recovery. Today, approximately 1 trillion cubic feet of gas per year is produced from unconventional resources, 90 percent of which comes from the tight blanket reservoirs.

The bulk of the Department's effort in tight sands research is concentrated at the Multi-Well Test Experiment in Colorado. At this field laboratory, research efforts contain elements of both applied research and proof of concept development specifically applied to the more difficult "lenticular" sandstone deposits; however, it should be noted that testing is at full scale, i.e., the experimental wells and stimulations are of commercial size.

The Devonian shale program contains both basic and applied research efforts. The research efforts should move into the "proof of concept" stage by the year 1990. Both the Devonian shale and tight sands program involve significant efforts in modeling, reservoir performance and stimulation activities.

The gas hydrate and deep source gas activities are still heavily involved in basic research and at this point, their primary focus is to determine if a meaningful resource exists. Assuming results are favorable, technologies for extracting meaningful quantities of production from these resources will not enter the "proof of concept" stage until the late 1990s.

---------------- DOE Position on UGR Pilot Testing ------------------

In a similar fashion to enhanced oil recovery, the principal focus of federally-sponsored research is on obtaining a comprehensive data base containing reservoir characteristics and other geologic information that will permit field tests to be conducted with greater predictability. The private sector will be the principal sponsor of the extensive number of field tests that will be needed to verify extraction technologies and strategies.

Comments on Proposed Legislation

The Committee's letter of invitation requested the Department to comment on various fossil energy R&D legislation now pending before the Congress, including H.R. 4182, H.R. 4392, H.R. 5044, H.R. 5048, H.R. 5592, H.R. 5593, S. 1278, and S. 1925.

The proposals offer several important benefits to the national effort for improving our technology base for utilizing coal:

1. The multi-year nature of the proposals provides a stable budget framework that would give both government and industry research managers greater assurances in planning longer-term research efforts; and

2. The programs encourage greater private sector involvement, a highly desirable factor in leveraging limited federal dollars and in shaping research projects that ultimately will be applied commercially by private firms.

On the other hand, we have several general concerns with these proposals:

- The proposals are overly prescriptive in designating specific technological concepts for research and development. These decisions are made more properly by private firms reading marketplace signals, rather than by the government through legislation.
- The proposals would authorize federal support for large scale demonstration-type projects. As we have previously stated, we believe these projects should be a private sector responsibility.
- The specific budget amounts provided in these proposals should be carefully examined, particularly in light of the current national need to restrain federal spending. The Department continues to advocate a program focused principally on the more generic research efforts that would enhanced the fossil energy knowledge base, rather than support specific technological development that benefits only one company or segment of the industry.
- Finally, the Department would not support transfer of funds previously appropriated for the Synthetic Fuels Corporation to the DOE fossil energy program, as provided in H.R. 5593. On May 25, 1984, the President transmitted proposed legislation that would implement a new synthetic fuels policy. The proposal would rescind \$9 billion of the \$19 billion originally appropriated to the Energy Security Reserve.

Conclusion

Since the inception of the President's Economic Recovery Plan in 1981, the Department of Energy has concentrated its efforts on the initial stages of fossil energy technology development -- basic research through proof of concept -- both to assist in reducing the growth in the federal spending and to preclude government interference in the proper market-based decisions necessary to select one technology over another for scale up to commercial or near-commercial sizes.

Accordingly, the Administration has generally not requested funds for projects beyond the proof-of-concept stage. Several financial alternatives are available, however, for the proponent of a specific process or technology. For example, various tax incentives have been provided for research and development expenditures through 1985. Action has also been taken to promote private sector arrangements that allow firms to conduct joint development efforts that might be too expensive for an individual firm to undertake.

Because they maximize the private sector's involvement in the selection of specific technologies and in other private investment decisions, mechanisms such as tax incentives and joint venture financing should be the preferred choices for private firms seeking assistance for large pilot plants or semiworks facilities.

Furthermore, continued government financial involvement in maturing technologies, particularly after a process has been deemed ready for commercial introduction, sends the wrong signals to lending institutions by implying that additional research is needed. Capital formation for emerging technologies therefore becomes more difficult as long as the government continues to play an active role.

Therefore, we would encourage those in the Congress and in the private sector who contend that certain technologies will not move through the latter stages of large-scale development without federal assistance to consider these financing alternatives rather than looking for direct financial involvement from the government.

As described in several examples throughout this testimony, when a technology has been deemed to have significant market potential, the private sector has not been reluctant to take the lead in providing project leadership and substantial financial participation.

This concludes my formal statment, Mr. Chairman. I would be pleased to answer any questions you or other members of the Committee may have.

Mr. FUQUA. Thank you very much, Bill.

You mentioned on page 9 about major construction projects. And there again, I guess semantics come into play, whether we're talking about pilot plants or semiworks or proof of concept, but if Congress were to establish a demonstration for R&D facilities, what criteria would you suggest that would be most important in establishing how the applicability of a project to the program—you mentioned the word "major;" I assume that might be a full-scale project. But what about a proof of concept facility?

Mr. VAUGHAN. I think the best way to answer that question, Mr. Chairman, is to talk about what we're trying to do with something like proof of concept. What we're trying to do is, we move things from an idea in somebody's mind up through this process to someday it is actually in the marketplace. We're trying to move up technically and answer all the questions about that technology or concept, whatever it is. When you reach what we have termed "proof of concept," what I think you are trying to get to is to have answered, in the minds of technical peers—and a large preponderance of technical peers—the basic questions about whether that concept or idea is going to work. Sometimes that's going to take a lot of benchscale testing; sometimes it's going to take scaling up from the laboratory and on to the point—and I think there is no major size or dollar amount at which that point or stage is reached—but somewhere along that line, most of the engineering and scientific community interested in energy matters and energy technology would agree that you have proven the concept.

Now, beyond that, before you get to offering it in the marketplace, you move on through a process, development stage, some people have called it semiworks, and eventually on to actually putting it in the marketplace, so-called commercialization. It is really in that next stage, beyond proof of concept, that you start doing several things that I think cause this administration's concern. One of the things you do, you are going to spend—when you move beyond, generally, proof of concept—a vast amount of money. The rate at which you must spend money at that stage is beginning to move up very rapidly for most technologies.

Second, you are having the Government, through its very presence, begin to make some marketplace choices because its very presence will begin to influence what the Nation then does commercially. We believe that the Government is not very well equipped to do that since it neither produces energy nor produces equipment for sale.

Another thing that happens with demonstration-level or semiworks facilities is that they are, by nature, generally much larger than was the proof, or what was necessary to prove the concept. At that stage they tend to hire lots of people; they tend to become members of communities, and they provide for you folks in the Congress and for localities some wrenching experiences when the process comes to an end, successful or not. What are you going to do about it, because we've gotten to the end of the process and are ready to move on to the next stage?

I have loosely termed that a kind of "old base" stage, and it's the problem that the Defense Department faces frequently of bases or installations that it no longer necessarily has a high priority for, but finds that the Congress has many pressures to keep those places open.

We have the same thing. The problem with that is that the base's bills—and we have the requirement to keep these places going—the veneer of funding gets thinner and thinner. In R&D, one needs to marshal resources and people, money and people, take some risks, make some decisions, and focus those in order to make the breakthrough. You spread it over a wide veneer, the danger is you will not move forward as boldly.

Yet another factor that concerns me, as I indicated, is that in times of budget constraint this is a large requirement on Federal funding; so what we think we need to do is more conservatively use the funds available, get more bang for the buck, from the public sector's point of view.

Thus, in this long, rambling answer to your question, it is very difficult to precisely define these concepts. I wish it were nice and neat, but it simply isn't, and it's going to require all of us in this process—the committee, the Congress, and we in the administration—to make judgments and stand accountable for those judgments. Hopefully, our batting record will be right most of the time.

Mr. FUQUA. Well, it's been my observation that most of the energy projects that you refer, about the constituency into the old base concept, it's not really true. I can think of one that comes to mind, the H-Coal facility down at Catlettsburg, KY. I don't think you saw a lot of pressure on Congress to continue; it had started out with a plan; it was bobtailed a little bit, but it went through, and it was closed down. I think that all of these with a plan, how far they're going to be demonstrated, is—there's only so much you can demonstrate. You can't keep going on and on.

Now, I think of another one that comes to mind—it's like the Curtiss-Wright facility up in New Jersey, which has been built. And yet, have there been any plans to operate that facility or go through the final phase of testing the facility and see if there's going to be a test run made there for a period of time for the proof of concept or proof of whatever that will happen—has the Department made a decision on that at this time?

Mr. VAUGHAN. We have not made an absolutely final decision, Mr. Chairman, but we have taken—we do have pending before us at this time an unsolicited proposal from interests in that area, both utility and technical, to run some tests. It is true that the Curtiss-Wright Corp. has formally notified us that it is not electing to proceed with phase IV, which is a test run. The reason they notified us to that effect was that, in phase III as they brought the project to completion of phase III, one of their duties was to attempt to find private sector financing to run phase IV. They served notice on us that, back last October, that they were unsuccessful in that effort and therefore they had no intention of moving forward into phase IV.

The unsolicited proposal that I mentioned is before us. I will tell you that we have done an analysis of the concept of running the facility, and in our judgment it will cost something in excess of $20 million to run that facility for roughly a 2-year test period in the context of the main facility being shut down and no longer useful and productive. In our view we do not get enough value in the Department's program to warrant that level of expenditure.

There has been some concern about the number of jobs that may be restored if such a test run were made, and I think one has to be quite careful which jobs one is talking about. To run these tests there will be very few jobs; clearly less than 50, in my judgment, and probably more accurately something on the order of a couple dozen. That should not be confused with the high level of employment, in the hundreds, that was involved with running the main engine to rebuild facility. I think there has been a little confusion in that regard.

There are still some options open that if, indeed, we find that electric power interests are committed to and believe there is substantial value in running this facility, perhaps something can be worked out. Let me broadly outline what I think might be possible.

We could donate the facility since we have no programmatic need for these results. In effect, we would have the Federal Government making a payment in kind, and that would also result—if we did such a thing—in the relieving of Curtiss-Wright of the obligation to dismantle the facility. That dismantlement right is worth something in excess of a million dollars.

Mr. FUQUA. Are you liable for that, or is that a Curtiss-Wright problem?

Mr. VAUGHAN. They are liable under the contract. And perhaps in the exchange of being relieved of that liability, it could help the sponsors of this project achieve the acquisition of the portion of the site they actually need on a more favorable basis.

It would seem to me, and I have had discussions with Curtiss-Wright, that the company is clearly in a cut its losses position, so I think they would entertain any kind of reasonable proposal. Obviously, they'll have to speak for themselves.

At this stage, what I'm trying to indicate to you is that, A, we don't think that it's worth it to proceed from a program point of view, and I don't think that I've seen anything that would indicate to me that there's a technical justification to change from that view. However, if there are interested parties, we'll try to work with them and—perhaps I've gone too far now in publicly discussing what might be possible. But I do want to indicate that we are openminded about it.

Mr. FUQUA. Well, in operating projects like that there are several R&D associations, like EPRI and GRI, who will testify later this morning, and they do provide some of the funds for some of the projects that you've testified about. But I'm sure they will probably testify that they cannot go forward with some of these unless there's some Government funds involved. Now, if they can't meet the funding demands and the Government refuses to fund, then who is going to do it? Or will it get done? Or can you work with groups like EPRI and GRI who feel that a project is worthy, and putting some of their funds in, and maybe some other mechanisms?

Mr. VAUGHAN. Well, I would—and again, this is not on the basis of any discussions, but I would think that if we were to be donating the full facility, and I think it would be quite doable to donate a facility to something like EPRI because it's a broad-based entity—if that were done, it might well change their funding calculus. I don't know.

Mr. FUQUA. I was not specifically referring to the Curtiss-Wright facility; I was referring to other technologies that EPRI and GRI might be interested in, in the broad context.

Mr. VAUGHAN. That is why I said in my statement, Mr. Chairman, while there is no project at the moment, in my judgment, that is facing a problem with the technology gap, if things proceed as we think and as the more detailed statement indicates, in the next several years there undoubtedly will be some that may face this gap. That is why I have stated that I think we need to be flexible.

But I think also, in crossing that gap, we need to encourage the private sector to stretch as far as it can in order to minimize the presence of the Federal Government and the necessity of the presence of the Federal Government in these projects because once we have moved beyond roughly the proof of concept stage, we are in some part of commercializing which is basically something the business should do and not something for the Government to do.

Another point about this, Mr. Chairman, I think is quite important and I have testified to this before. Our role, as we see it, is to do long-range, high risk R&D, generic. There is nothing wrong with bringing concepts through that process up to proof of concept and if they're out of time commercially, it will keep; the knowledge will keep. It can sit on the shelf until such time, in my judgment, as the financial situation, the marketplace, alters and someone decides to take it off the shelf and commercialize it.

Mr. FUQUA. There's one fallacy to that argument, and it's a good argument from an economic standpoint; but when you factor in the political standpoint—and I'm really speaking of political uncertainty of energy sources that we have in the world—and if you have a blockage of the Straits of Hormuz, we have to start sharing oil shortfall with Europe and Japan; we start drawing on our strategic reserve and then we suddenly say, "Hey, we'd better start developing some technologies here because we might need them in about three months." How do you answer that?

Mr. VAUGHAN. Most projects in the nature of long-term R&D will be nowhere near 3 months. Yes, we may well move some projects if we make the decision to do so; and certainly when the Congress and administration decided several years ago to pass the SFC legislation, in those technologies this Nation so made such a judgment, that it wanted to spend the money to move projects much beyond this stage. But I think what I'm saying to you is, that that is a very costly process and a process that—today, we're in different times. Back when we passed that legislation we were facing a serious—what we judged to be a serious crisis, and almost all forecasters expected rather rapidly rising energy prices in the future. We have seen that those judgments were wrong.

We would be paying out considerable sums, in my judgment, had we had something like an SFC format where we were much further down the road and the loan guarantees had to be paid off. We're in a different situation today. Demand is down; there's an oil glut in the world. Yes, there's unrest in the Middle East; and yes, we should be concerned about it. But the situation is vastly different, in my judgment.

Again, you finally get to the point of whether we can afford it; and that, of course, the Congress and the administration—constantly there is a tension, always a tension, about what we can afford. And I think that's really, in part, what we're discussing.

Mr. **Fuqua**. Well, it's certainly a valid point. Nobody predicted, as you pointed, that oil prices would be where they are today. I still think, though, that it behooves us as a Nation, even if oil was 25 cents a barrel, to move forward and try to develop some alternatives because we know, just as sure as I'm sitting here—unless some miracle happens, and I realize that can happen because I used to believe in the tooth fairy—that these things are going to change. We're running out of oil, of fossil fuel, particularly oil and gas. Even though there have been new finds, we're still using it faster than it's being made. It doesn't take too smart a person to calculate that out, that someday we're going to be in deep trouble, plus when you factor in the political uncertainty that prevails in the world today.

I just hate to sit here and say—not that we have to totally convert to synthetic fuels; I'm not advocating that—but I'm sure advocating that while we have time, we sure better start proving the concept that this stuff will work, and ferret out the white elephants and move on to those that have potential, that we can utilize the resources that we have in our own country and have access to in a better manner than we're doing today.

That's where I have a basic philosophical difference, and I know people with honest intentions can differ. I have a very strong difference with the administration and with the Department of Energy about this particular policy because I think it behooves us as a Nation to try to move forward and develop the technologies. At least we'll know whether they work or not. We won't even know whether they'll work or not; some of them—I know there's a lot of snake oil salesmen out there, and I met a lot of them, but at least we can try to pick out the ones that look promising, try to make sure that they will work.

I don't think it will be very long, not very many years—before, we thought that oil would be at $40 a barrel now—it will be there, and it will probably be a lot higher than that. It won't be very long down the road, and it'll be very competitive at that time.

So I beg to disagree with you, and I still respect you; but I think we are being very shortsighted. I have been around this place for a while and I remember in 1973 and 1974, and I remember 1978 and 1979, and I don't want to go through that again. I don't think the country wants to go through that again. We've had time to do something but we haven't; we've debated and debated and debated, and we've had different opinions and so forth, but I don't think the American public is going to be very happy if that happens again, and they will say, "What were you guys doing all during this time when you knew we were eventually going to have a shortfall of petroleum?" And I think we're not doing it.

In the committee report for the bill we reported this year, it indicated for a 5-year program for National Coal Science Technology and Engineering Development Research Plan, we outlined that and asked for it by October of this year. Is the Department planning to comply with that request?

Mr. VAUGHAN. We certainly do intend to respond to the request of the committee. Yes, sir.

Mr. FUQUA. In the——

Mr. VAUGHAN. Mr. Chairman, if I may on that?

Mr. FUQUA. Sure.

Mr. VAUGHAN. I think what we're talking about still, though, is a matter of degree. It is my position that when you go through proof of concept you have answered the basic questions of whether it works. What you're doing beyond that is durability, performance testing, and a number of other things in the move toward commercialization. So we are materially different under our proposed way of approaching this than we were, say, ten years ago when we had neither of these activities very well developed. And there certainly is a difference in degree, but the idea of proof of concept is to have determined which ideas, and to take them far enough, to have determined that yes, they do work, and that then they are ready to go on to that next stage of commercialization. And that next stage, however long it might be, is essentially an economic process and a scale up process, in my view, as I say—in the nature of durability testing, performance runs—maybe a succession of scale ups. Some technologies will require that.

So I think we are talking about matters of degree.

Mr. FUQUA. Well, maybe we're getting closer than I thought because I was not aware of how far you meant proof of concept to go, whether it be a bench test or whether it would be some form of a demonstration. And I realize that's kind of a fuzzy area, from the laboratory to where you have some form of demonstration, and that has——

Mr. VAUGHAN. Let me try to respond with something very complex, MHD. You know, we've been working for some time on MHD in our community, and we are sending up to the committee today a revised program plan for MHD. It calls for significantly increased commitments and finances.

But let me talk about proof of concept there. That technology is very complex and has a number of essential components. Each of those components is sufficiently complex that, in my judgment, a proof of concept stage must be reached with each of those subsystems, and then I think it is legitimate to say that some kind of proof of concept must be gone through for putting them together. We think that's going to take several more years; in fact, this program plan will tell you that we think it's going to take another ten years—and it has been ten years—of Federal and private effort to move this technology to full use by the electric power industry. And I'm convinced it will be successful.

Mr. FUQUA. Will this be a full scale test or a partial scale test?

Mr. VAUGHAN. We believe that the first and the most efficacious way to answer those questions is through retrofit at a utility; but we believe there must be proof of concept of subsystems.

There are other technologies, Mr. Chairman, where there is simply the technology and one proof of concept and that's it. And then there is this scale up.

Now, let me point out that even at the end of that 10 years, with proof of concept and even with the retrofit, we won't have answered all the questions about MHD even if it's working out. It may be some time after that before utilities are using the concept broadly. That's what I would expect to happen; but the point is, we are moving forward to answer these questions, that technically we have proved out each of these concepts and we have good scientific and engineering grounds to move to the next stage and believe they will work. Always the possibility that something will go wrong.

But my point is that the nation knows that once we've done each of those steps, that we have the knowledge and we don't regress.

Also I will say, and I think I've said before this committee, when you do high risk long-range research you have what a lot of people will call failures. Yes, in the sense of ultimately working, they are failures; but in the sense of moving technology forward, they are necessary. We must stumble a few times before we can run and I think we are very much encouraging that we take risks at the high risk end. And that's something that the Government is better equipped to do at that stage than is the private sector, and we're not shrinking from that.

Mr. FUQUA. As we're trying to unravel what your concept of proof of concept is, let me ask some more specific questions.

In the H-Coal facility, would you consider that a proof of concept, the facility at Catlettsburg?

Mr. VAUGHAN. We think it was essentially a little bit beyond proof of concept, yes, sir.

Mr. FUQUA. So it could be semiworks or demonstration?

Mr. VAUGHAN. It has gone on beyond there.

Mr. FUQUA. Well, what about the Exxon Donor Solvent?

Mr. VAUGHAN. Same thing.

Mr. FUQUA. Well, what about the BIGAS Program?

Mr. VAUGHAN. About the same.

Mr. FUQUA. Now, how about all the type of work that GRI and DOE are engaged in? Would you call that—like in the gasification plant, would that be proof of concept?

Mr. VAUGHAN. That's too broad for me to really—some yes, some no. We are engaged, Mr. Chairman, as in your opening statement you indicated, in some projects that you, the committee, and Congress thought we should be engaged in, that is beyond proof of concept. And there are some of those activities going on.

Mr. FUQUA. Could you provide some of those for the record that you would consider proof of concept that you have with GRI?

Mr. VAUGHAN. We would be happy to.

[The information follows:]

JOINT DOE/GRI/EPRI PROJECTS CONSIDERED AT THE PROOF-OF-CONCEPT STAGE

The following is a list of joint DOE EPRI and DOE/GRI projects that Fossil Energy views as proof-of-concept projects:

EPRI—Advanced Physical Coal Cleaning Project in Homer City, Pa.; Selected Projects with the Mining & Industrial Fuel Gas Association (MIFGA); Direct Liquefaction—Wilsonville Advanced Coal Liquefaction Research Facility is considered by FE to be a proof-of-concept project. Indirect Liquefaction—The LaPorte Liquid Phase Methanol (LPMeOH) PDU facility represents a proof-of-concept project for this improved methanol technology.

GRI—Waltz Mill/Westinghouse Gasifier; Consolidated Natural Gas (CNG) Acid Gas Removal; and Partial seam test of CRIP ignition process for underground coal gasification.

EPRI/GRI—Fuel cell R&D in phosphoric acid area (40 kw on-site field tests).

Mr. FUQUA. And for that matter too, primarily GRI, because I think they are more involved in what I would consider proof of concept based on our exchange—but identify some of those projects you would consider, and you can supply that for the record.

Mr. VAUGHAN. Be glad to. Yes, sir.

Mr. FUQUA. Thank you.

Mr. Boucher?

Mr. BOUCHER. Thank you, Mr. Chairman.

Mr. Vaughan, what is your view of the Department of Energy participating with private concerns on a cost-share basis in the construction of demonstration facilities? Is there a willingness to do that if private industry contributes a portion of the funding?

Mr. VAUGHAN. I think it is fair to say we would prefer not for the reasons of how it uses funds and so on. But I think we have indicated in this testimony and previously that if we reach the stage where it looks like a technology is moving along and even has gone to proof of concept and it looks like it may stumble, then we think we ought to be flexible—well, I certainly do—think we ought to be flexible enough, particularly if there's a high amount of participation by that private sector interest, to go a little further. Because one of the problems, and I hope I made this clear in my remarks earlier, is that while we are using these terms, semiworks, proof of concept, they are not clipped, precise points. Every one of them is a judgment call and I don't personally think we ought to impede the progress of technology by rigid definitions. But I do think that private sector should have looked in those cases at tax incentives and at combined, joint venturing with other elements of the private sector; and then if we become involved, we should be sure that that is—that there is as much leveraging of the Government's dollars as possible. Also, that minimizes our influence and control. When you're in that commercial end of things, the closer you get to it the less control the Government should have, in my opinion.

On the other hand, as you well know, sir, if you put Federal dollars into projects there has to be some control. Everybody agrees with that; you've got to be sure that the public gets something for its money.

So we should not be rigid; that's the simple answer to your question.

Mr. BOUCHER. Well, I think that's an encouraging answer. Let's assume that, for a given project, the industry that is developing that demonstration project convinces you and satisfies the test that you've just outlined, that they have searched for tax credits, that they have looked at possible joint venturing, and essentially have covered all of that ground; and they still are not able to come forward with sufficient funding for the demonstration project.

Now, at that point what level of commitment would the Department of Energy be willing to put forward? Would it be 50 percent of the funding, assuming that you evaluate the project as worthwhile? Would it be some lesser or some greater share?

Mr. VAUGHAN. I think at that stage we certainly should not have to—in general, I would say that it ought to be at least 50-50 and as much higher as the private sector can afford to come up with. In other words, a minimum Federal involvement.

On one of our projects right now, we are involved to the tune of only 15 percent; and that is one of these projects involving, if I recall, EPRI. I believe our involvement, if my numbers are right, is about 15 percent. In that sense, it's ideal. We are beyond, in that case, the proof of concept and in a kind of pure sense we didn't think it was necessary to go beyond that. But we have moved beyond it, partly at the urging of the Congress, but notice that we've moved along only enough to have it go. And I think it's going.

Mr. BOUCHER. So the extent of your flexibility then would be, assuming that you are convinced of the appropriateness of the project and of the difficulty of the private investor accumulating sufficient funds for it, your flexibility would extend up to perhaps as much as 50 percent of the cost as the Government's participation?

Mr. VAUGHAN. One caveat, Congressman, and that is of course that I have a budget process in the administration to go through, and I must convince my bosses and the keepers of the Treasury, OMB, that it makes sense and that we should be involved here. And I think that kind of checking and balancing is appropriate. But yes, I think I would—certainly, the instruction to our people is that there is no absolute closed door. I think I have indicated that in conversations with representatives of quite a wide range of technologies in the private sector, and I try to be candid with them about my estimates of how successful I'm likely to be. That varies, too, depending on a number of factors unique to each technology.

Mr. BOUCHER. Do you feel that you have sufficient statutory authority today to participate as an equal partner on a 50-50 basis, for example with private industry, in carrying out a facilities program?

Mr. VAUGHAN. Yes, sir. I believe we have ample statutory authority, frankly, to go beyond that.

Mr. BOUCHER. And so you don't feel any of your authorities need modifying or amending to enable you to participate that fully?

Mr. VAUGHAN. No, sir.

Mr. BOUCHER. OK.

Let me say that I wholeheartedly share the statements made by the chairman with regard to the need to move forward with demonstration projects as a means of enhancing our Nation's energy independence. But I'll go one step beyond his statements and say that I think there are some other legitimate aims that can be advanced and which we can realize through demonstration projects.

I know that you, personally, have gone down to my district, to Bristol, VA, and have witnessed the work that is underway at United Coal Co. where they are presently working on a microbubble flotation process which will reduce the ash and sulfur content of coal. Now, commercialization of that process, obviously, could help us satisfy some of our Clean Air Act problems, so I think in addition to solving energy independence problems, which clearly is a great potential of these projects, we can go further and solve environmental problems that are very serious today, as well.

Now, that being the case, you've got a situation where a private coal company has made already a very substantial investment in that kind of research; but, as I'm sure you learned on that trip, the company cannot move forward and build the demonstration project for coal cleaning. Doesn't that create the kind of environment—again, not making specific commitments to a given project—but doesn't that create the kind of environment where it's proper for the Government to play a role in helping to finance the demonstration project?

Mr. VAUGHAN. I think the correct answer to that, Congressman, is it may. I certainly share your view that there are other legitimate public purposes beyond simply energy nondependence or lessening of dependence. Certainly, environmental—acid rain concerns—are among those. Enhancing competition is yet another. And, you know, we've been throwing other factors around here and not enumerating them, but there certainly are other factors. And I do think those, and perhaps there are some others that I haven't thought of at the moment, are legitimate, and I think they need to be put in that balance.

I must say when I was down there, I was very impressed when I was at United Coal Co. They were quite progressive, involved with their own funds in R&D, and I think that industry needs a lot more of that. I might add, it makes it a lot easier for the Federal Government then to become involved and assist, where necessary, when the private sector itself is moving forward aggressively.

There are certain other companies in that industry, unfortunately, who are not similarly progressive and they make it difficult for us to be appropriately involved.

Mr. BOUCHER. Well, thank you very much for that. I share your view that that particular coal company is one of the industry leaders in research, and I join you in hoping that others will follow suit in the near future.

It's encouraging for me to hear you say that in a situation like that, there is an appropriate role for DOE to be of assistance. Given that fact, and given the willingness of DOE to be flexible in participating as a partner with private enterprise in demonstration projects, why then is DOE so reluctant to accept some additional funding to make that participation possible? We have heard testimony during the last day from a number of Members of Congress and others that, given the current problems that the Synthetic Fuels Corporation and the sluggishness with which the Corporation has advanced on a number of fronts, that perhaps it would advance the overall goals of achieving energy independence for the country to have some of the budget authority which SynFuels presently possesses, about $14 billion, transferred to the Department of Energy for the purpose of allowing you to construct demonstration projects.

Agreeing that there is a proper role for you in that area, as I think you have, why are you so reluctant to receive the funding that would make that participation possible?

Mr. VAUGHAN. I think the answer to that, Congressman, is twofold. One, I think that while we've indicated that we need to be flexible in these areas, we certainly, in general, do not believe that it is necessary or appropriate, generally, to be involved in the demonstration and commercialization process. There, we fundamentally disagree, and I think that's reason one.

Reason two is that we have put together a budget that we think uses our personnel, matches the needs of the country at the time, and that we can properly manage. And were we to just massively throw large amounts of money back in this program, I certainly would be concerned that we get back to the situation that existed not too many years ago where the Department was shoving money out the door with wild abandon because it was so handily funded with much pressure from the Congress to get it out the door and get it used. There were some very unfortunate results of that process.

Obviously I feel, as a member of this administration, that we have serious budget problems; and I back the decisions of my bosses that we need, in the balancing process, to restrain everything. Yes, these are good things, perhaps, to do, but we are making the judgment that we can't afford to go that far. And there will always be that kind of disagreement.

Mr. BOUCHER. Well, given what appears to be a disagreement as to whether the Government should be involved in helping to finance demonstration scale projects, let me get you to respond to the testimony which is going to be forthcoming after you depart from EPRI and from the Gas Research Institute. Their view is very different from yours. They are saying, with regards to the Electric Power Institute, that they have to have at least 6 months of demonstration work for small scale projects, and 2 to 5 years of demonstration work for larger projects before they'll make any substantial investments on their own in those technologies. And they're not prepared to come forward with full financing for those projects at this time. That's going to be the thrust of their testimony, as I read it.

Now, how do you respond to that? You say there's no gap between research and commercialization. They are saying that, in fact, there is. Are they incorrect in that statement?

Mr. VAUGHAN. I think there, Congressman, you have to go to the specifics, because I think that in both sets of testimony there are enumerated their views about specific projects and their view that there is a gap. In those particular situations, we do not concur with their technical judgment about those specific projects. That is a general statement on my part, and I certainly am prepared to go to each one specifically and point out why we don't have the same view.

[The information follows:]

DOE REACTION TO FUNDING TECHNOLOGIES
PROPOSED BY GRI/EPRI

Technology	Proposed By	DOE Funding	Justification
Texaco Partial Oxidation Gasifier	EPRI	Disagree	This concept of coal gasification is currently being operated at several demonstration/commercial scale facilities. The Cool Water project, Tennessee Eastman and the Dow Chemical Company effort all are using the Texaco Gasifier at feed capacities up to 1,000 tons per day of coal. In addition, the Texaco pilot plant facility at Oberhausen, Germany, is continuing to be operated. The development of this concept is well along the path of commercialization.
British Gas Corporation-Lurgi Slagging Gasifier	EPRI	Disagree	This technology is the property of the British Gas Corporation and has been developed through the pilot plant stage in part through the continued interest and financial support of the DOE. This concept was the gasifier proposed for the CONOCO High-Btu Demonstration Plant. When that effort was ended and as a result of many other factors, the British Gas Corporation decided to continue the development of the gasifier at a demonstration scale in their Westfield Lurgi Coal Gasification Plant. A demonstration scale gasifier with a diameter of 8-feet has been constructed at the Westfield site and will be started up this summer. BGC has stated that it is their intent to develop this concept through the demonstration stage. EPRI currently is negotiating with BGC to start a test program that would utilize U.S. coals. There also has been some discussion about the continued development of this gasifier as a separate unit to be installed at the Great Plains Coal Gasification Plant (GPCGP). It is not believed, however, that the development of the concept is being delayed due to lack of DOE support of a demonstration effort.

Technology	Proposed By	DOE Funding	Justification
Shell Gasification Process	EPRI	Disagree	Considerable activity was observed in the development of this concept up to 1982. At that time Shell International postponed its efforts to build a 1,000 ton per day facility and, accordingly, reduced its other development efforts. Although very little activity has been evident in recent years, it should be noted that it always has been the position of the Shell organization that the development of this concept would be supported entirely by Shell and at a schedule consistent with their Corporate plans. There is no known effort on the part of Shell to solicit support for the development of the reactor. More recently, however, Shell Oil, located at Houston, Texas, has joined Shell International in this program and some reports have been received about a proposed development effort that may be initiated near the Shell facility at Houston. The gasifier concept has been developed through the pilot plant stage (150 tons per day) at Harberg, Germany. In addition, EPRI has sponsored tests on U.S. lignite coals in this pilot plant as evidence of its continuing interest in the concept. As was the case with the BGC/Lurgi gasifier, there is no evidence to indicate that the development of this concept is being delayed by the lack of a DOE supported demonstration program.
160 Mw TVA AFB Demo	EPRI	---	DOE already involved.
AFB Retrofit of Northern States Power 15 MWe Oil-Fired Unit	EPRI	Disagree	EPRI, NSP are proceeding.
Circulating Fluid Bed Technology at Colorado-Ute	EPRI	Disagree	Utilities should determine potential and sponsor accordingly.

Technology	Proposed By	DOE Funding	Justification
Curtiss-Wright/PFB Facility	EPRI	Disagree	No programmatic need.
Coal Water Slurry-Utility Boiler Evaluations	EPRI	Disagree	SFC has issued a solicitation related to coal water slurry mixtures for use in utility and industrial applications. Eleven responses were received by the June 15, 1984 closing date. Six of the eleven proposals were for projects to produce fuel for use in industrial facilities, and five were for projects to produce fuel for electric power generation. SFC intends to make two price guarantee awards under this solicitation, one for a project to produce fuel for industrial facilities, and one to produce fuel for electric utility power plants.
Chiyoda Flue Gas Scrubbing	EPRI	Disagree	Near-term product improvement.
Scaleup of Catlettsburg, Kentucky H-Coal pilot plant	EPRI	Disagree	The private sector could propose such an initiative to the SFC for loan and price guarantee assistance. However, there may be practical reasons why scale-up of H-coal at Catlettsburg is not feasible because it may not be cost effective to revamp and increase capacity at that site; tie ins with Ashland refinery may not be available and Ashland may not be a participant in the project; and industrial co-funders may have alternate sites for the project.
Scaleup of LaPorte project to large pilot plant (approx. 100 tons per day)	EPRI	Disagree	FE believes that the technology for liquid phase methanol has significant potential and assuming satisfactory results from current R&D efforts, is a candidate for scaleup within a few years. The 100 TPD capacity would be a 20 fold increase over the present facility and is considered appropriate for the next evaluation. If the private sector agrees with our assessment of the potential of this technology, then there should be a serious private interest in supporting such an activity, either with private funds, or perhaps with SFC assistance.

Technology	Proposed By	DOE Funding	Justification
Limestone-Based Dual Alkali Flue Gas Scrubbing	EPRI	Disagree	Near-term product improvement.
NO_x Control	EPRI	Disagree	EPA is supporting.
Dry Sorbent SO_2 Control (Synthetic Nahcolite Process)	EPRI	---	Under evaluation for possible acid rain control application.
LIMB	EPRI	Disagree	EPA is supporting.
Magnetohydrodynamics	EPRI	Agree	In terms of planned POC demonstrations (DOE definition) not cited in the EPRI/GRI testimony but planned by DOE, they include: (1) MHD topping cycle POC (late 1980s); (2) MHD bottoming cycle POC (late 1980s); (3) MHD seed regeneration POC (late 1980s).
High Temperature Combustion Turbine Technology	EPRI	Agree	In terms of planned POC demonstrations (DOE definition) not cited in the EPRI/GRI testimony but planned by DOE, they include: (1) Coal-fired gas turbine POC (late 1980s); and (2) Coal-fired diesel engine POC (late 1980s).
Phosphoric Acid and Molten Carbonate Fuel Cell Integration with Coal Gasification Technology	EPRI	Agree	Included in DOE Fuel Cell Program.
Refurbish 4.8 Mw Con-Ed Phosphoric Acid Facility	EPRI	Disagree	The 4.8 Mw project has been deactivated and the equipment will be protected and stored at the site until a decision is made pending its disposition. The 4.8 Mw demonstration in Japan should establish the commercial potential of this technology.

Technology	Proposed By	DOE Funding	Justification
Advanced Gasifier at Great Plains	GRI	Disgree	Both the developers of the advanced gasifier as well as the management of GPGA are supportive of an effort to design, construct and operate a demonstration advanced gasifier at the GPCGP. However, DOE believes that this can be accomplished with private financing.
Coal conversion or utilization technology with coal bed methane extraction operation	GRI	Disagree	The DOE role in the coalbed methane area is one of providing fundamental research to fill identified data gaps, not to conduct major field demonstrations. This latter activity has been conducted by GRI with DOE serving in a technical advisory capacity. DOE plans to continue in this mode of operation.

Mr. Boucher. Well, I'm sure we'll be hearing testimony from those witnesses during the course of this hearing concerning some of their specific projects. I, for one, would be interested in seeing your response to the statements they make.

Mr. Vaughan, I want to thank you for being with us today and for sharing that testimony, and let me take this opportunity also to thank you for the trip you did take down to the coal company in my district. I know the people there much appreciated it and were very encouraged by the interest you showed.

Thank you, Mr. Chairman.

Mr. Fuqua. Thank you, Mr. Boucher.

Bill, if we could, we may leave the record open. We may have some additional questions we'd like to submit to you in writing, of which you could respond likewise.

Mr. Vaughan. That's fine, Mr. Chairman. We'd be pleased to answer, and Congressman Boucher, we'd be pleased to answer those specifics if you frame the questions that you'd like for us to answer. We'll make those comparisons and get back to you.

Mr. Boucher. Thank you.

Mr. Fuqua. Thank you very much for being here this morning.

Mr. Vaughan. Thank you, sir.

Mr. Fuqua. We appreciate your testimony.

Our next two witnesses will be Mr. Dwain Spencer, vice president, advanced power systems, Electrical Power Research Institute, and Mr. David Webb, senior vice president, policy and regulatory affairs of the Gas Research Institute. Let me welcome you two gentlemen this morning. Mr. Spencer, we'd be pleased to hear from you at this time.

STATEMENT OF DWAIN F. SPENCER, VICE PRESIDENT, ADVANCED POWER SYSTEMS, ELECTRIC POWER RESEARCH INSTITUTE

Mr. Spencer. Thank you very much, Congressman Fuqua.

Mr. Chairman, it is a pleasure to address this subcommittee relative to the importance of a Federal Government role in supporting demonstration scale facilities for fossil, particularly coal, and renewable energy technologies and to highlight some of our experience in carrying out large scale system development and demonstration projects using cooperative agreements and partnership arrangements for financing advanced power and process technology developments.

I am Dwain Spencer, vice president of the advanced power systems division of the Electric Power Research Institute. In this capacity I am responsible for EPRI's coal conversion, advanced power, and renewable resource system development. Although these remarks are my own views, they are a result of my close working relationship with both the electric power industry and the DOE and ERDA fossil and renewable energy programs over the last 9 years.

During EPRI's first 10 years of service to the electric power industry of this Nation, our technical programs have evolved from long-term research and development to emphasis on shorter term engineering services and full-scale demonstration activities. It is this present emphasis on the need for full commercial scale demonstration projects on which I would like to focus my remarks.

As you are quite aware, historically the electric utility industry has generally maintained a very conservative investment posture in relation to adopting new generation technologies. As Congressman Boucher said very well just a few moments ago, I am personally convinced that the utility industry, in general, will require operation of full-scale facilities for any new technology for periods of at least 6 months for small, few-megawatt scale systems, and 2 to 5 years for large—hundreds of megawatts—power systems before they will make significant commercial investments in new technologies. You understood my remarks very well, and that is the essence of my message.

Before discussing the approach which we have taken at EPRI to demonstrate key technologies, I would like to mention some key benefits of modular power generation systems which relate directly to your considerations. Modular power systems utilizing fossil or renewable energy sources have some key advantages over large-scale plant types such as nuclear or direct coal fired powerplants from a demonstration plant standpoint. Specifically, these advantages include, one, full plant operating performance can be obtained at smaller scale—hundreds of kilowatts to hundreds of megawatts capacity increments, rather than multihundreds of megawatts to thousands of megawatts.

The financial threshold to demonstrate the processes are less and the private sector is more likely to take a significant, but lower, financial risk.

Thirdly, these plants have design through construction periods of 2 to 5 years; therefore, operating experience can be obtained within a short time of the financial commitment.

As a result of our assessment of the benefits of modular technologies, EPRI has focused its research, development and demonstration activities on a few economically attractive modular systems with the endorsement of our utility advisory committees. During the last 6 to 7 years we have focused on coal and renewables, but have selectively included advanced technologies which utilize fluid fuels more efficiently as a means to demonstrate the value of advanced technologies.

Both of my division's major demonstration projects are being carried out within the State of California, namely, the 100 megawatt Cool Water Integrated Coal Gasification Combined Cycle powerplant near Daggett, Ca., in conjunction with Southern California Edison and other partners, and the 65 megawatt Heber binary cycle demonstration project in the Imperial Valley being carried out in conjunction with San Diego Gas & Electric, the Department of Energy, and other partners, in which this committee has played such an important role in supporting the DOE position relative to Heber.

These two projects represent EPRI's first commitments to the design, construction and extended operation of new technologies at the full commercial module scale which show promise of being economically competitive with other baseload generating systems.

A key element in establishing the capital for these projects, and I want to emphasize this to you, is the development of joint funding and management agreements among numerous parties whose financial participation may range from a few million dollars to over $100 million. Based on my last 6 or 7 years of experience, let me say that establishing these financial and management agreements, obtaining financial closure, and implementing strict financial and management control on such projects is a challenging and demanding task, and I think Bill Harvey is very aware of some of the aspects of that that we've gone through in these projects.

I would just like to briefly comment on the status of these projects because, in my opinion, they should serve as models for the conduct of similar projects in the future. The 100 megawatt Cool Water project was funded at a level of $294 million by a private sector consortium led by Southern California Edison, Texaco, EPRI, Bechtel, General Electric, the Japanese Cool Water Partnership, Eseerco, and recently, Sohio. The funding commitments range from over $100 million from EPRI to $5 million from both Eseerco and Sohio. Construction of the plant was completed in mid-April; initial Syngas from coal was produced on May 7; the first electricity production from a large scale, fully integrated combined cycle plant was produced on May 21, and the first integrated gasification combined cycle power was generated on May 31. As of last Sunday, we have just completed our first 4-day continuous run wherein over 6,500 megawatt hours of power were produced at Cool Water. This project presently is estimated to reach successful extended duration operation during the summer or early fall of this year, at which time the price guarantee awarded by the U.S. Synthetic Fuels Corporation, for up to $120 million of assistance during the early years of operation, will become effective. As you are well aware, this is the first award made by the SFC, and this support was vital to the continuation of the project. It brings up one of the points I'll make later, and that is, we must concern ourselves not only with capitalization, but also operating cost subsidies for these first five demonstration facilities since they are not commercially viable systems.

The 65 megawatt Heber binary cycle project is also proceeding quite well. We have nearly completed detailed engineering of the facility and construction is presently over 30 percent complete. This project is being conducted under a cooperative agreement with the Department of Energy, San Diego Gas & Electric, EPRI, the State of California Department of Water Resources, The Imperial Irrigation District, and Southern California Edison. Again, financial commitments by the parties range from a few million dollars to DOE's commitment of $60 million.

The interests of a broad range of organizations have been brought together to provide the capital for the project. In addition, the State of California Public Utilities Commission ruled that due to the special nature of this project, that all reasonable operating costs for the plant could be reflected in San Diego Gas & Electric's rate base. This decision, rendered in May 1983, was a very farsighted decision by the Commission, in our judgment, and was key to continuation of the project. Thus, in this case, the State of California ratepayer is also a partner in this project in attempting to develop a new technology which can broaden the geothermal resource potential of California and many contiguous states.

Based on this experience, I think there are some important lessons that we have learned which I would like to share with you in your considerations here today.

First, since these first of kind, full-scale demonstration modules are not cost competitive with commercially-available systems, funding commitments or subsidies are required not only for plant engineering and construction—that is, the capitalization—but also to subsidize extended plant operations, and I emphasize extended plant operations.

Second, the conduct of large-scale demonstration projects, considering present U.S. energy costs, clearly requires some type of Federal Government assistance in the form of capital and/or an operating cost subsidy. As you may recall, Mr. Chairman and Mr. Boucher, early in the Cool Water project we were attempting to carry the project entirely with private sector funding. We did successfully reach that objective from a capital standpoint; as energy costs then dropped in the early 1980's, we found ourselves then with a significant operating cost deficit. As a consequence, we then had to appeal to the Synthetic Fuels Corporation for support. So I firmly believe that in some way, the Federal Government is going to have to help these type projects if they are going to be finally consummated.

Third, the Heber and Cool Water projects are as close to the economically competitive margin as new technologies are likely to be, so that Federal support for other advanced fossil or renewable resource demonstrations will be even more important. This is particularly true on renewable resources which are primarily fuel displacers and must be measured against the price volatility of oil and gas.

Fourth, Federal Government commitments, once made, must be honored over 5 to 10 years if developers are to be confident that the Government is a reliable partner. I must again state that that is a very important element in us making major capital decisions in order to be certain that we will, indeed, be able to complete a given project.

Fifth, selection of those technologies to be demonstrated at large scale should be made extremely carefully by the private sector in conjunction with the Federal Government to maximize the probability for these systems to become truly commercially viable. Private sector proprietary rights and ownership should be protected, while providing for royalty income to the Government and other partners from commercial plants.

Sixth, private sector cost sharing of at least 50 percent should be required for large-scale demonstration projects to demonstrate that the private sector commitment to the technology is indeed real, and to minimize taxpayer exposure to demonstration of commercially unattractive technologies. In other words, we should "put our money where our mouth is," as well.

Seventh and last, modular power systems of hundreds of kilowatts to hundreds of megawatts are likely to become extremely important utility system additions in the 1990's; therefore, planning and conducting meaningful fossil and renewable technology demonstrations in the late 1980's will provide us the basis for commercial plants in the 1990's.

With your permission, Mr. Chairman, I would like now to briefly mention those prospective technologies which could be candidates for full-scale demonstration facilities in the late 1980's. These are covered in more detail within my written testimony which I would like to submit totally for the record, but summarize that for you.

Mr. FUQUA. We will make that part of the record, and you may summarize.

Mr. SPENCER. Thank you.

First, I'd like to identify a key area of continued interest to the utility industry, which is coal gasification systems and the advantages there are that these systems may be utilized either for life extension of existing oil- and gas-fired capacity, or for new generation in the form of integrated coal gasification-combined cycle systems. As Mr. Boucher so well stated a few moments ago, our primary incentive for this technology is that it offers the promise of being a cost-competitive, environmentally sound way to utilize a broad range of U.S. coals, and most especially high sulphur Eastern and Midwestern bituminous coals.

We have identified three second generation coal gasification technologies of primary interest, namely, Texaco partial oxidation, the British Gas Corporation-Lurgi slagging gasifier, and the Shell gasification process, all of which have been operated successfully at the large pilot plant scale, that is, greater than 150 tons per day thruput. Our Cool Water project, along with the experience being obtained by Tennessee Eastman and Ube Ammonia in Japan, should provide us a firm basis for commercial introduction of the Texaco partial oxidation technology. However, there are presently no plans for full-scale plants in the United States using either the Shell or BCG-Lurgi technologies, and these technologies are high on my priority list for early full-scale demonstration projects.

Another key direction of EPRI's advanced coal utilization program is atmospheric fluidized bed combustion. EPRI has decided to proceed with a demonstration of this technology at approximately a 160 megawatt scale in conjunction with TVA, Duke Power, and the State of Kentucky. This $200 million project will involve an investment of $75 million by EPRI, and construction is to begin in 1985 with a 4 year testing program. Congress has authorized DOE to provide approximately $30 million for this project, and DOE's financial support is greatly appreciated.

There are two additional projects being planned with Northern States Power Co., and Colorado-Ute on two other fluidized bed technologies. The experience from these three projects would demonstrate a range of AFBC technologies for potential use by the electric utility industry beginning in the 1990's. Partial Federal funding for these projects would most certainly expedite the private sector initiatives to the projects.

Pressurized fluidized bed combustion may provide even further advantages in efficiency, modularity, and cost reduction for direct coal-fired generation; however, commitments to the demonstration of this technology are dependent on continued operation of the Grimethorpe and Curtiss-Wright PFBC pilot facilities. Continued DOE participation is encouraged in those facilities to accelerate the availability of test results.

Coal-water mixtures is another very significant potential area. EPRI has sponsored tests on coal-water slurries with DuPont to assess the potential for substitution in industrial boilers, and obtained very satisfactory results. It is now imperative to conduct full-scale coal-water slurry production, shipment, and combustion tests to truly evaluate the potential for fuel substitution in utility boilers. The potential wide scale applications of coal-water mixtures could be severely restricted if slurry production and boiler conversion costs, including environmental control considerations, are too high and significant capacity deratings are necessitated. Federal Government support for the demonstration of meaningful production quantities and test burns is extremely important over the next few years.

Turning now to coal liquefaction, during the last ten years EPRI has also played a key role in conjunction with ERDA and DOE in defining, developing, and evaluating a broad range of coal liquefaction technologies such as H-Coal, the Exxon Donor Solvent Process, and Two Stage Liquefaction. At a time when nearly all the major oil companies have terminated their research and development programs on coal liquids, we continue to support the only operating U.S. coal liquefaction pilot plant at Wilsonville, AL in conjunction with DOE and Southern Company Services. The recent advances at Wilsonville to improve both product yields and fuel quality has been exciting and rewarding. Continued operation of this facility through the end of 1986 appears to be in the national interest.

We continue to believe that direct hydroliquefaction offers the Nation an important insurance policy in the event of import curtailments.

There has also been similar progress in the indirect synthesis of liquids, for which I will refer you to the testimony. But I do have one very strong recommendation to offer for your consideration. Rather than allowing the technical capability that we have developed in direct hydroliquefaction over the last few years to be lost, we believe that a prudent program to utilize and upgrade the Catlettsburg, KY H-Coal pilot plant is also in the national interest. Specifically, I recommend that a program directed toward the design, engineering, construction, and operation of a single pioneer commercial train, of a capacity in the 1,000 to 2,500 tons per day range, be considered at Catlettsburg to provide a firm engineering basis for full-scale commercial coal liquefaction plants.

In addition to the need for advanced coal conversion and utilization technologies, there is a continuous need to demonstrate full-scale environmental control technologies for direct coal-fired power plants. These include the Chiyoda gypsum-producing gas-sparged SO_2 scrubbing system, a large prototype or full-scale module demonstration of limestone-based dual alkali SO_2 scrubbing system, large prototype or full-scale demonstration of retrofittable low-NO_x burners and advanced overfiring air technologies, large prototype demonstration of advanced sodium and high-reactivity calcium sorption of SO_2 in a flue gas in conjunction with fabric filters, and other such systems for control of flue gas emissions.

In the longer term, the Federal Government, EPRI, and the private sector have also been supporting a range of other advanced coal utilization technologies which may technically mature during the next few years and become candidates for full-scale demonstration plants. These technologies include open cycle MHD, molten carbonate fuel cell, and high temperature combustion turbine, both integrated with coal gasification technology. All of these systems show promise of more efficiently utilizing coal and, therefore, in my opinion warrant continued R&D support with an eye to the future prospect of selecting one or more of these technologies for full-scale demonstration.

We continue to believe that additional Federal support for the Phosphoric Acid Fuel Cell development and the 4.8 megawatt fuel cell demonstration program at ConEd is warranted, and my written testimony includes specific comments on the recent progress in this technology.

I would simply like to state that a decision to refurbish and modernize, where feasible, the New York City powerplant would provide the opportunity to obtain extended reliability, performance and endurance testing data that is necessary to minimize the risk of a commercial design.

And finally, turning to the renewable technologies, as this subcommittee knows, the Department of Energy-SCE 10 megawatt solar thermal pilot plant near Barstow has met its performance objectives. However, attempts to obtain funding for a 50 to 100 megawatt solar thermal project, such as the Solar 100, has been unsuccessful. We believe that a Solar 100 scale project would appear to be a meaningful next step in demonstrating the potential of this technology.

In the area of wind technology, the Federal Government has clearly been the spearhead for development of multimegawatt wind turbines. Although our economic analyses indicate that such systems are marginally competitive only in high, continuous wind environments, such as Hawaii, completion of the planned Mod 5 program with at least a single supplier would appear prudent.

And finally, turning to photovoltaics, during the last 10 years, as I'm sure you are well aware, significant progress has been made to define system requirements and costs for a central station PV system. Recent advances in high concentration photovoltaic designs indicate that first demonstration modules could be deployed within the next 2 to 3 years. Beyond that period, advances in tandem amorphous silicon, single-crystal ribbons, and other noncrystalline cells may meet performance and economic requirements. Therefore, I see a continuing necessity to assess and demonstrate the long-term performance and stability of photovoltaic cell modules of various types, and I again feel Federal Government support is critical to a timely evaluation of the potential benefits of these systems.

There are other numerous, small, renewable energy systems, particularly wellhead geothermal systems, that may also be candidates for future demonstration systems.

Finally, in summary, Mr. Chairman, I greatly appreciated the opportunity to testify before your subcommittee today. I truly believe, from my experience, that the Federal Government must play a meaningful and effective role in financially supporting key technology demonstrations over the next 5 to 10 years if we are to maximize our potential for utilizing domestic resources and minimize our dependence on foreign supplies of energy. We at EPRI are committed to the research, development, and demonstration of a broad range of modular, clean power systems in capacity increments from hundreds of kilowatts to hundreds of megawatts using domestic energy resources.

An expanded Government role, coupled to industry, can only enhance the prospects of successfully achieving this goal. We are delighted to see this subcommittee's interest in this most important area, and stand ready to work effectively with the Federal Government in meeting the intent of the Congress.

Thank you very much.

[The prepared statement of Mr. Spencer follows:]

REMARKS ON THE IMPORTANCE OF A FEDERAL GOVERNMENT ROLE IN SUPPORTING DEMONSTRATION SCALE FACILITIES FOR FOSSIL (COAL) AND RENEWABLE ENERGY TECHNOLOGIES

Dwain F. Spencer
Vice President
Advanced Power Systems Division
Electric Power Research Institute

Testimony Presented to:

Subcommittee on Energy Development
and Application
Committee on Science and Technology
United States House of Representatives
Washington, D.C.

7 June 1984

I) Introduction

Mr. Chairman, it is a pleasure to address this subcommittee relative to the importance of a federal government role in supporting demonstration scale facilities for fossil (coal) and renewable energy technologies and to highlight some of our experience in carrying out large scale system development and demonstration projects using cooperative agreements and partnership arrangements for financing advanced power and process technology developments. I am Dwain Spencer, Vice President of the Advanced Power Systems Division of the Electric Power Research Institute. In addition, I have served as a member of the Department of Energy's Fossil Energy Advisory Committee since 1976 and on the Advisory Board of the Solar Energy Research Institute since 1982. Although these remarks are my own views, they are a result of my close working relationship with both the electric power industry and the DOE and ERDA fossil and renewable energy programs over the last nine years.

II) The Importance of Demonstration Projects and the Need for Federal Government Support

During EPRI's first ten years of service to the electric power industry of this nation, our technical programs have evolved from long-term research and development to emphasis on shorter term engineering services and full-scale demonstration activities. It is this present emphasis on the need for full commercial scale demonstration projects on which I would like to focus my remarks. As you are quite aware, historically the electric utility industry has generally maintained a very conservative investment posture in relation to adopting new generation technologies. I am personally convinced that the utility industry, in general, will require operation of full-scale facilities for any new technology for periods of at least six months for small (few megawatt scale systems) to 2-5 years for large (hundreds of megawatt) power systems before they will make significant commercial investments in new technologies.

Before discussing the approach which we have taken at EPRI to demonstrate key technologies, I would like to mention some key benefits of modular power generation technologies which relate directly to your considerations. Modular power systems utilizing fossil or renewable energy sources have some key advantages over large-scale plant types such as nuclear or direct coal fired power plants from a demonstration plant standpoint. Specifically, these advantages include:

1) Full plant operating performance can be obtained at smaller scale (hundreds of kilowatts to hundreds of megawatts capacity increments).

2) The financial threshold to demonstrate the processes are less and the private sector is more likely to take a significant, but lower, financial risk.

3) These plants have design through construction periods of 2-5 years; therefore operating experience can be obtained within a short time of the financial commitment.

As a result of our assessment of the benefits of modular technologies, EPRI has focused its R/D&D activities on a few economically attractive modular systems with the endorsement of our utility advisory committees. During the last six to seven years we have focused on coal and renewables, but have selectively included advanced technologies which utilize fluid fuels more efficiently as a means to demonstrate the value of advanced technologies. Both of my division's major demonstration projects are being carried out within the State of California, namely, the 100MW Cool Water Integrated Coal Gasification Combined Cycle (IGCC) power plant near Daggett, California in conjunction with Southern California Edison Company and other partners, and the 65MWe Heber Binary Cycle Demonstration Project in the Imperial Valley being carried out in conjunction with San Diego Gas & Electric, the Department of Energy, and other partners.

These two projects represent EPRI's first commitments to the design, construction and extended operation of new technologies which show promise of being economically competitive with other baseload generating systems, such as direct coal fired power plants and light water reactors in the West and in the case of the IGCC technology many other regions of our country, particularly the Midwest and East.

A key element in establishing the capital for these projects is the development of joint funding and management agreements among numerous parties whose financial participation may range from a few million dollars to over one hundred million dollars. Based on my last six or seven years of experience, let me say that establishing these financial and management agreements, obtaining financial closure, and implementing strict financial and management control on such projects is a challenging and demanding task.

I would just like to briefly comment on the status of these projects as, in my opinion, they should serve as models for the conduct of similar projects in the future. The 100MWe Cool Water Project was funded at a level of $294 million by a private sector consortium led by Southern California Edison, Texaco, EPRI, Bechtel, General Electric, the Japanese Cool Water Partnership, ESEERCO, and recently, SOHIO. The funding commitments range from over $100 million from EPRI to $5 million from both ESEERCO and SOHIO. Construction of the plant was completed in mid April, initial Syngas from coal was produced on May 7, the first electricity production from a large scale, fully integrated IGCC plant was produced on May 21, and the first integrated gasification combined cycle power was generated on May 31, 1984. The project presently is estimated to reach successful extended duration operation during the summer or early fall at which time the price guarantee awarded by the U.S. Synthetic Fuels Corporation, for up to $120 million of assistance during the early years of operation, will become effective. As you know, this is the first award made by the SFC, and this support was vital to the continuation of the project.

We believe the dedication and quality of personnel assigned to the Cool Water project, in both labor and management, has produced a truly first-class facility. The project is presently approximately one month ahead of schedule and $30 million under budget. The nation will clearly benefit from this project as it will permit the cleanest use of all types of bituminous coals ever developed for power production. In fact, Mr. Chairman, it is the only electric utility facility licensed for coal use within the State of California, and we will be testing both high and low sulphur coals at the plant. We look forward to obtaining operating experience from this facility over the next few years and clearly establishing the technical and economic readiness of coal gasification combined cycle power plants.

The 65MWe Heber Binary Cycle Project is also proceeding quite well. We have nearly completed detailed engineering of the facility and construction is presently over 30 percent complete. This project is being conducted under a cooperative agreement with the Department of Energy, San Diego Gas & Electric, EPRI, the State of California Department of Water Resources, The Imperial Irrigation District, and Southern California Edison. Here financial commitments by the parties range from a few million dollars to DOE's commitment of $60 million. Again the interests of a broad range of organizations have been brought together to provide the capital for the project. In addition, the State of California Public Utilities Commission ruled that due to the special nature of this project, that all reasonable operating costs for the plant could be reflected in San Diego Gas & Electric's rate base. This decision rendered in May of 1983, was a very farsighted decision by the Commission and was key to continuation of the project. Thus the State of California ratepayer is also a partner in this project in attempting to develop a new technology which can greatly broaden the geothermal resource potential of California and many contiguous states.

Mr. Chairman, there are some extremely important lessons to be learned from our experience in financing and conducting these projects which should be considered in carrying out future projects of this type, namely,

1) Since these first of kind, full-scale demonstration modules are not cost competitive with commercially available systems, funding commitments, or subsidies, are required not only for plant engineering and construction (capital) but also to subsidize extended plant operations.

2) The conduct of large-scale demonstration projects, considering present U.S. energy costs, clearly requires some type of federal government assistance, in the form of capital and/or an operating cost subsidy.

3) The Heber and Cool Water Projects are "as close to the economically competitive margin" as new technologies are likely to be, so that federal support for other advanced fossil or renewable resource demonstrations will be even more important. This is particularly true on renewable resources which are primarily fuel displacers and must be measured against the price volatility of oil and gas. (Of course, as you know, the Congress has already appropriated $30 million for the 160MWe TVA, EPRI, Duke Power, State of Kentucky atmospheric fluidized bed demonstration project to be constructed at Paducah, Kentucky.)

4) Federal government commitments, once made, must be honored over periods of 5-10 years if developers are to be confident that the government is a "reliable partner".

5) Selection of those technologies to be demonstrated at large-scale should be made extremely carefully by the private sector, in conjunction with the federal government, to maximize the probability for these systems to become truly commercially viable. Private sector proprietary rights and ownership should be protected, while providing for royalty income to the government and other partners from commercial plants.

6) Private sector cost sharing of at least fifty (50) percent should be required for large-scale demonstration projects to demonstrate the private sector commitment to the technology and to minimize taxpayer exposure to demonstration of commercially unattractive technologies, i.e., "we should put our money where our mouth is".

7) Modular power systems of hundreds of kilowatts to hundreds of megawatts are likely to become extremely important utility system additions in the 1990s; therefore planning and conducting meaningful fossil and renewable technology demonstrations in the late 1980s will provide us the basis for commercial plants in the 1990s.

III) Prospective Technologies for Demonstration Scale Facilities in the Late 1980s

A) Coal Gasification or IGCC Plants

The advantages of coal gasification to the electric power industry are different and more immediate than in the unregulated sector of industry. The two most likely applications of this technology to electric power generation are:

- Life extension for existing oil and gas-fired capacity.
- Integrated coal gasification-combined cycle (IGCC) for new capacity.

The gasification of coal to produce Syngas (carbon monoxide and hydrogen) has been a key focus for the electric utility industry's advanced coal utilization program for over ten years. The primary incentive for this technology is that it offers the promise of being a cost competitive, environmentally sound way to utilize a broad range of U.S. coals, and most especially high sulphur eastern and midwestern bituminous coals. In addition, EPRI has established an objective of demonstrating a range of coal gasification processes capable of utilizing the full range of U.S. coals from bituminous to sub-bituminous coals and lignites.

We have identified three second generation coal gasification technologies of primary interest, namely Texaco Partial Oxidation, the British Gas Corporation-Lurgi (BGC-Lurgi) Slagging Gasifier and the Shell Gasification process, all of which have been operated successfully at the large pilot plant scale, i.e., greater than 150 tons/day thruput. Our Cool Water project, along with the experience being obtained by Tennessee Eastman and Ube Ammonia in Japan, should provide a firm basis for commercial introduction of the Texaco partial oxidation technology. However, there are presently no plans for full-scale plants in the U.S. using either the Shell or BGC-Lurgi technologies, and these technologies are high on my priority list for early full-scale demonstration projects.

B) Atmospheric Fluidizied Bed Combustion

Another key direction of EPRI's advanced coal utilization program is atmospheric fluidized bed combustion (AFBC). Again, EPRI has supported research and development on this concept for nearly ten years and developed the basic understanding of the performance of these systems in a 6'x6' test facility constructed and operated for EPRI by Babcock and Wilcox (B&W). The performance and design data from this unit has provided the technical basis for the 20MWe pilot plant built by B&W for TVA in Paducah, Kentucky, and is presently in operation. The pilot plant has essentially confirmed the earlier results.

As mentioned above, EPRI has decided to proceed with a demonstration of this technology, at approximately the 160 MWe scale, in conjunction with TVA, Duke Power and the State of Kentucky. This $200 million project will involve an investment of $75 million by EPRI. Construction is to begin in 1985, with a four year testing program to commence in 1989. The AFBC Development Corporation, made up of the four principals, has been formed as a mechanism for other interested parties to contribute financially to this demonstration project. The Congress has authorized DOE to provide approximately $30 million for the project and DOE's financial support is greatly appreciated.

At the same time, we have been studying the practicality of AFBC's retrofit of coal and oil fired units. A northern States Power (NSP) 15 MWe oil fired unit has been retrofitted with a fluid bed to burn wood chips and other fuels. As a result, NSP is now proceeding, with EPRI assistance, to convert an existing 100 MW pulverized coal-fired unit to AFBC firing which will raise its capacity to 125 MW. A third demonstration project is under consideration by Colorado-Ute and would utilize circulating fluid bed technology. The experience from these projects would demonstrate a range of AFBC technologies for potential use by the electric utility industry beginning in the 1990s. Partial federal funding for these projects would most certainly expedite the private sector initiatives to these projects.

C) Pressurized Fluidized Bed Combustion

Pressurized fluidized bed combustion (PFBC) may provide further advantages in efficiency, modularity and cost reduction for direct coal-fired power generation. The successful achievement of these advantages continues to depend, however, on the operation of both the Grimethorpe and Curtiss-Wright PFBC pilot plants.

The joint efforts of DOE and the private sector have been effectively addressing the technical questions which pace this generation option. It is most important that these efforts be maintained so the potential advantages of PFBC can be commercially realized within the next decade. Continued DOE participation is also encouraged to accelerate the availability of test results. A cost-shared proposal, led by Public Service Electric and Gas in New Jersey, with EPRI participation, has been made to DOE for operating of the Curtiss-Wright facility. Implementation of this proposal could resolve the several system design and control issues limiting PFBC scale-up.

D) Coal-Water Mixtures

Although each specific situation must be investigated independently, there are two alternative emerging approaches for extending the useful life of existing oil and gas fired units, medium-Btu gas as discussed previously, and coal-water mixtures. EPRI has sponsored tests with DuPont to assess the potential for substitution of coal-water mixtures (CWM) in industrial boilers and obtained very satisfactory results. It is now imperative to conduct full-scale coal-water slurry production, shipment and combustion tests to truly evaluate the potential for fuel substitution in utility boilers. The potential wide scale applications of CWM could be severely restricted if slurry production and boiler conversion costs, including environmental control considerations, are too high and significant capacity deratings are necessitated. Federal government support for the demonstration of meaningful production quantities and test burns is extremely important over the next few years.

E) Coal Liquefaction

During the last ten years, EPRI has also played a key role in conjunction with ERDA and DOE in defining, developing, and evaluating a broad range of coal liquefaction technologies such as H-Coal, the Exxon Donor Solvent Process, and Two Stage Liquefaction. In addition, we have conducted numerous tests to assess the combustion and emission characteristics of these fuels in boilers, combustion turbines, and diesel engines. In fact, we have spent over $100 million in attempting to develop clean, petroleum substitute fuels for the electric power industry and the nation.

At a time when nearly all of the major oil companies have terminated their research and development programs on coal liquids, we continue to support the only operating U.S. coal liquefaction pilot plant at Wilsonville, Alabama in conjunction with DOE and Southern Company Services. The recent advances at Wilsonville to improve both product yields and fuel quality (lower sulphur and nitrogen content fuels) has been exciting and rewarding. We continue to believe that direct hydroliquefaction offers the nation an important insurance policy in the event of import curtailments. As we look ahead, and judge that our nation's imports will again exceed 8 million barrels per day by 1990, we continue to believe that both continued research, development, and demonstration of indirect and direct synthesis of liquid fuels is an important national priority.

Recent progress in indirect synthesis of liquids from coal which has been made in our jointly funded 3 ton/day once thru methanol synthesis unit at LaPorte, Texas has been very encouraging. Methanol and higher alcohol product yields have met or exceeded our expectations using once thru synthesis from unshifted Syngas. It now appears that this technology is an excellent candidate for scale-up to a large pilot plant scale of approximately 100 tons/day within the next few years.

As stated above, a great deal of experience and understanding has been developed relative to direct coal liquefaction from the EDS, H-Coal, and Wilsonville pilot plant efforts over the last ten years. Rather than allowing this technical and operating capability to be lost within our country, we believe that a prudent program to utilize and upgrade the Catlettsburg, Kentucky H-Coal pilot plant is in the national interest.

Specifically, I recommend that a program directed toward the design, engineering, construction, and operation of a single Pioneer commercial train (capacity of 1000-2500 tons/day) be considered at Catlettsburg to provide a firm engineering basis for full-scale commercial coal liquefaction plants. The plant design should consider the ability to co-process crude oil and coal as well as include modifications necessary to demonstrate scale-up of the two stage coal liquefaction process such as that being developed at Wilsonville, Alabama.

F) Environmental Control Technologies

Conventional pulverized coal-fired power generation has associated with it a number of unresolved environmental control issues that are the subjects of active R/D&D programs by EPRI and several state and federal government agencies. Second-generation wet S02 scrubbing processes for improved reliability, combustion modification for NOx control, and both postcombustion and during-combustion capture of S02 by dry sorbents, are technologies that are technically and economically attractive based on proof-of-concept testing and, in some cases, small prototype development programs. Due to scale-up uncertainties, coupled with the magnitude of capital investment that would have to be risked for their full-scale implementation, they require the intermediate step of large prototype demonstration testing before they can confidently be implemented in the electric utility industry. Specific examples of technologies whose availability could be accelerated by federal participation in this intermediate step, or which may not become available without such participation, are listed below.

Wet S02 scrubbing

a. Single module (100 MW) demonstration testing of Chiyoda CT-121 gypsum-producing gas-sparged S02 scrubbing system, on high-sulphur pulverized coal fired utility boiler flue gas with a closed water loop (zero discharge). (Small prototype tests by EPRI.)

b. Large prototype (20-40 MW) and/or full-scale module demonstration testing of limestone-based dual alkali (sodium solution scrub with limestone regeneration) SO2 scrubbing system. (3 MW pilot testing in progress by EPRI and FMC.)

NOx control - Large prototype (20-40 MW) and full-scale demonstration testing of retrofittable low-NOx burners and advanced overfire air technology, in existing tangential-fired, wall-fired circular, and cell burner boilers. (Proof of concept, bench scale, and single burner testing by EPRI and EPA.)

Dry sorbent SO2 control

a. Large prototype demonstration of advanced sodium (synthetic nahcolite) and high-reactivity calcium sorption of SO2 in a flue gas with collection on a fabric filter. (Proof of concept by EPRI and DOE.)

b. Large prototype demonstration testing of SO2 sorption in the furnace onto limestone ("LIMB"). (Proof of concept by EPRI, bench-scale testing by EPA and EPRI.)

G) Other Candidate Coal Utilization Technologies

The federal government, EPRI, and private industry have also supported a range of other advanced coal utilization technologies which may technically mature during the next few years and become candidates for full-scale demonstration plants. These technologies include open cycle magnetohydrodynamics, the molten carbonate fuel cell (integrated with coal gasification technology), and high temperature combustion turbine technology. All of these systems show promise of more efficiencly utilizing coal and, therefore, in my opinion warrant continued R&D support with an eye to the future prospect of selecting one or more of these technologies for full-scale demonstration.

H) Phosphoric Acid Fuel Cell

As you are aware, UTC, Westinghouse, DOE, Consolidated Edison of New York, EPRI and numerous Japanese companies have been supporting the continued development and demonstration of the phosphoric acid fuel cell. Using traditional fuels such as natural gas or distillate oil, the 4.8 MW system in Japan has achieved a heat rate of 9300 Btu's per kilowatt hour. The experience also has confirmed the system's minimal pollution characteristics and the power plant's ease and acceptance for siting in the most difficult and constrained locations. The difficulties at the Con Ed 4.8 MWe plant in New York have not yet allowed us to obtain similar experience in the U.S. due to the long shelf life required of the fuel cell stock for the plant. However, a decision to refurbish and modernize, where feasible, the New York City power plant would provide the opportunity to obtain extended reliability, performance and endurance testing data that is necessary to minimize the risk of a commercial design. Finally, I would simply like to state that commercial phosphoric acid fuel cell power plants in the 10 to 50 MWe capacity range could be operated on coal-derived Syngas similar to the integrated coal gasification combined cycle power plant. The fundamental issue that remains to be resolved is the cost and performance associated with such plants. Continued government support for phosphoric acid demonstrations could lead to commercial systems using conventional fuels in the late 1980s.

I) Solar Thermal

As this subcommittee knows, the DOE-SCE 10 MWe solar thermal pilot plant near Barstow has met its performance objectives; however, attempts to obtain funding for a 50-100 MWe solar thermal project, e.g., Solar 100, have been unsuccessful. Although the solar thermal central receiver, or power tower concept, is limited to high direct sunlight areas, commercial plants in the 100 MWe class appear marginally competitive with oil fired boilers. Therefore, a Solar 100 scale project would appear to be a meaningful next step in demonstrating the potential of this technology.

J) Wind

The federal government has clearly been the spearhead for development of multi-megawatt wind turbines. Although our economic analyses indicate that such systems are marginally competitive only in high, continuous wind environments such as Hawaii, completion of the planned Mod 5 program with at least a single supplier would appear prudent. Units should be deployed in a few different geographic and climatic regions to assess the breadth of the geographic value of such systems.

K) Photovoltaics

During the last ten years, significant progress has been made to define system requirements and costs for central station photovoltaic (PV) power plants. With existing tax laws, multi-megawatt non-concentrating commercial PV systems have been and are being deployed. Recent advances in high concentration PV designs indicate that first demonstration modules could be deployed within the next 2-3 years. Beyond that period, advances in tandem amorphous silicon, single-crystal ribbons, and other non-crystalline cells may meet performance and economic requirements. Therefore, I see a continuing necessity to assess and demonstrate the long-term performance and stability of PV cell modules of various types and, again, federal government support is critical to a timely evaluation of the potential benefit of these systems.

L) Other Potential Renewable Energy Technology Candidates

In addition to these key solar technology demonstrations, there are a wide variety of other potential renewable energy candidates which may emerge over the next few years. These include various types of wellhead, hydrothermal conversion systems, total flow systems for geopressure resources, newer types of low head hydro plants, and biomass production, conversion, and utilization systems. All of these technologies are at various stages of R&D and many may be ready for full scale evaluation over the next few years.

IV) Summary

Mr. Chairman, I greatly appreciated the opportunity to testify before your subcommittee today. I truly believe that the federal government must play a meaningful and effective role in financially supporting key technology demonstrations over the next five to ten years if we are to maximize our potential for utilizing domestic resources and minimize our dependence on foreign supplies of energy. We, at EPRI, are committed to the research, development, and demonstration of a broad range of modular, clean power systems in capacity increments from hundreds of kilowatts to hundreds of megawatts using domestic energy resources. As I stated recently in my testimony before the Senate Energy Subcommittee on Energy Research and Development, an expanded government role, coupled to industry, can only enhance the prospects of successfully achieving this goal. We are delighted to see this subcommittee's interest in this most important area, and stand ready to work effectively with the federal government in meeting the intent of the Congress.

Thank you very much, Mr. Chairman, for the opportunity to address your subcommittee.

Mr. BOUCHER. Thank you, Mr. Spencer. We will have questions for you following the testimony from Mr. Webb.

We will be glad to hear from you at this time.

STATEMENT OF DAVID O. WEBB, SENIOR VICE PRESIDENT, POLICY AND REGULATORY AFFAIRS, GAS RESEARCH INSTITUTE

Mr. WEBB. Thank you very much, Congressman Boucher.

I appreciate the opportunity to appear before you today to discuss the Gas Research Institute's views on the need for Federal support of fossil energy and conservation research test facilities at a scale above proof of concept but at less than commercial size.

Before discussing the need for these facilities, however, I would like to emphasize that an expanded and consistent fossil energy conservation and research program and funding for these programs in the Department of Energy is equally as important as Federal support for pilot and demonstration facilities. We must have both for a viable national program.

As a first step toward this consistent program, the gas industry has recommended in its previous testimony before this committee a total of $108 million for gas-related research in the DOE fossil energy budget, and $22 million in the conservation research budget. These budget recommendations are essentially the same as appropriated by Congress for fiscal year 1984, and are consistent with the previous initiatives and leadership actions taken by this subcommittee and Congress. In this regard, we wish to thank you and the subcommittee for your support in this vital research area.

The Gas Research Institute is a research and management organization which cofunds and coordinates many of its research programs with the Department of Energy. Therefore, the actions of Congress on the DOE budget have a direct impact on the gas industry's research program. In this context, I am presenting my comments today from the perspective of a funder of research with a corporate policy of not proceeding beyond proof-of-concept without direct industry involvement.

GRI fully supports a major Federal role in the demonstration of emerging fossil energy and conservation technologies. However, before discussing my views on the DOE program and why it is needed to fill this technology gap, based on conversations that were previously held here this morning by DOE witnesses, I believe it would be useful to clearly understand the role that supplemental energy supplies will have to play in meeting the U.S. energy demands in the early part of the 21st century, which is really only 16 years from now.

DOE Secretary Hodel last week in a speech noted that in 1983, oil and gas supplied 67 percent of America's energy and is forecast to supply more than 60 percent of our energy for at least the next 10 years. However, it is clear that an increasing source of this energy must come from other than traditional reservoirs and formations, or that these resources will have to be produced in new, nontraditional ways.

As an example of the problem, despite whopping increases in crude oil prices during the 1970's, proven U.S. oil reserves have dropped by 10 billion barrels since 1970 from nearly 40 billion barrels then to less than 30 billion barrels now. In Texas, traditionally the Nation's top producer, daily oil output has declined by about 700,000 barrels per day since 1977. Even more recently, at Alaska's North Slope, site of the greatest oil discovery in U.S. history 16 years ago, the main reservoir at Prudhoe Bay already shows signs of wear, and oil companies are now injecting water into the formation just in order to maintain current flow rates.

At the same time, while the United States has a short-term gas deliverability surplus now, more and more of the required gas supplies will have to come from supplemental sources by the year 2000. Natural gas production from the lower 48 resources will decline precipitously in the 1990's and significant supplemental gas supplies will be needed thereafter. Some estimates are as much as 4 trillion cubic feet a year, or the equivalent of 2 million barrels of oil per day by the year 2000.

What do such predictions mean for the development of technology associated with obtaining supplemental supplies? Essentially, the technology base to develop these supplemental supplies requires a lead time of anywhere from 10 to 15 years. Unless DOE takes the lead, industry on its own will not develop these technologies in sufficient time to avoid future shortages.

Due to the uncertainty of future world oil prices, if we do not take the steps necessary to develop the technology base, the level of oil imports will rise rapidly, again increasing our dependence on insecure oil from politically unstable regions.

Another question I think we ought to address is, has Federal policy created a technology gap? In my opinion and that of the gas industry, the current Federal research policy has created a technology gap. The issue is how to build and demonstrate large-scale advanced coal conversion and utilization processes so that they will be available when needed to meet demands for supplemental energy supplies. Currently, neither DOE nor the Synthetic Fuels Corporation supports this essential and risky step in technology development. As Assistant Secretary Jan Mares testified last October, the Department's current R&D program does not entail process development. However, the process development stage is perhaps the most crucial stage in the development of a new technology. It is during this stage that a good technical idea is turned into a process with commercial potential.

In his testimony last October Mr. Mares also indicated that the administration was willing to reassess the future role for process development. More recently, last month, Assistant Secretary Vaughan testified:

> In addition, our policy of encouraging significant cost-sharing as a prerequisite for consideration of large-scale development efforts should provide industry with a clear signal of the requirements necessary for Federal support of projects that are beyond the laboratory and the bench-scale development stages.

These recent DOE statements are encouraging. However, today's DOE statement is somewhat confusing to me on what their policy actually is; therefore, a clear policy of Federal support for technology demonstrations is required before industry will enter into a partnership to build these critical plants.

I think it should be recognized that the economics of these plants are driven by the price of world oil, and the price of oil is not based in economics but on pricing by cartel. Therefore, many of the administration's rationales for why they should not support these demonstration programs in my opinion are based on a faulty premise. If we have learned anything over the past 10 years, it is that our ability to accurately predict the energy future is somewhere near zero. The Nation needs these types of plants to reduce this uncertainty.

To close the technology gap, we see the DOE role in fossil R&D as having three essential components: Basic research, exploratory or proof-of-concept phase research—and at this phase industry should be involved in the research—and finally, large pilot plants or demonstrations. In this phase processes and components in a scale sufficient in size to easily extrapolate the commercial module need to be tested for engineering design and economic evaluation. The actual size of the facility will vary with the process, but they could range from 200 tons up to 1,000 tons of coal or equivalent per day. It is imperative that this phase have significant industry cofunding and, in my opinion, industry management of the daily construction and operation of the test facility. Without all three parts there can be no expectation as to research funded by DOE and by the taxpayer, that it will actually be commercialized by industry. This, in my opinion, is false economy.

In examining the demonstration program concept, I would suggest that the administration consider developing and demonstrating advanced processes, where feasible, at existing commercial synthetic fuel plants where most of the necessary components and required services are already in place. For instance, it would make sense to examine operating a new, more advanced gasifier, or perhaps gasifier systems, at the Great Plains plant where all of the coal handling and downstream equipment are already in place rather than building a stand-alone plant.

I think Congress should also consider requiring the Synthetic Fuels Corporation to place a priority in its awarding the projects that propose slip-stream testing or propose to make facilities available to demonstrate advanced processes at this same commercial plant site.

Finally, while Congress is contemplating a new coal demonstration program for DOE, I would like to point out that any change in the authority or program of the Synthetic Fuels Corporation which could result in the abandonment of committed commercial plants, such as the Great Plains coal gasification plant before it is actually operational, could significantly impact the Nation's coal gasification program.

The lack of information, if that plant is not operated, creates a major void in any large coal conversion program.

By way of conclusion, I'd like to recommend and make the following points regarding what I see are critical in any joint Federal-industry program.

First, the Congress must recognize that DOE has a clear role in demonstrating new coal conversion and utilization technologies. There is an absolute need for the Federal Government to continue the natural progression of development from a new technology through the laboratory and proof-of-concept phase, through the technology demonstration phase.

Second, the Federal Government must accept the industrial cosponsor as a full partner in the demonstration of a synthetic fuels process, even where the Federal Government is a major source of the funds.

Third, the private partner must be responsible for providing a significant portion of the construction and operation costs of the facility. It only makes sense, then, for the private partner to also be responsible for selecting the process, the plant site, the size of the demonstration program, and managing the project.

Fourth, since the Federal Government will be providing a minimum of 50 percent of the funds for these types of projects, the Congress and the executive branch should take several steps to ensure that the project operates in an environment which will minimize cost overruns and the exposure to the taxpayer. The first step is to develop total program costs for these major energy projects and include these careful estimates in the Federal budget.

The second step is to provide for a single authorization for the design, construction, and operation of the plant once the Congress and the administration have decided to proceed with the project.

The third step should be for Congress to provide for multiyear appropriations so that the plant construction and operation can be based on programmatic concerns and not that of the annual, cyclic rhythms of the budget process.

Fifth, the executive branch should leave the day-to-day management of the project to the industrial partner. The Synthetic Fuels Corporation Act incorporated a sound philosophy on the role of the SFC program managers that I feel should be adopted by DOE. The SFC participation is "limited to financial participation only and shall not include any direct role in the construction or operation of the module." Even in the case of direct funding by the SFC, the act makes it clear that "In no event . . . shall the persons in the joint venture agreement be denied the primary responsibility for management of the joint venture." I think that's sound if we're going to go forward and commercialize these programs.

Sixth, in passing legislation, I think Congress should not try to be too specific in specifying the technologies, the size of the demonstration, nor the type of plant site at which they should be conducted.

And finally, in determining which proposals to select, I think consideration should be given to recognizing that a stand-alone plant will usually be the most expensive type of technology demonstration, and therefore should only be considered as a last resort. Priority should be given to doing demonstration at existing plant sites to make use of existing facilities.

In conclusion, the current Federal energy research policy has created a technology gap for nonnuclear research, and there is a need for a viable Federal role in the applied and engineering research phases of coal conversion and utilization processes. Without this Federal support, the timely development of advanced processes to use the Nation's vast coal resources in an environmentally acceptable manner will be seriously delayed. A joint DOE/industry program is needed now.

Mr. Chairman, that completes my oral statement and I would like, if there is no objection, to include my complete statement in the record. I'd be happy to respond to any questions that you or the other members may have.

Mr. Boucher. Without objection, your full statement will be included in the record, Mr. Webb. We thank you very much for your testimony.

[The prepared statement of Mr. Webb follows:]

STATEMENT OF DAVID O. WEBB, SENIOR VICE PRESIDENT
POLICY AND REGULATORY AFFAIRS, GAS RESEARCH INSTITUTE
BEFORE THE ENERGY DEVELOPMENT AND APPLICATIONS SUBCOMMITTEE
OF THE COMMITTEE ON SCIENCE AND TECHNOLOGY
UNITED STATES HOUSE OF REPRESENTATIVES
JUNE 7, 1984

I appreciate the opportunity to appear before you today to discuss the Gas Research Institute's (GRI) views on the need for federal support of fossil energy and conservation related test facilities at a scale above "proof-of-concept" but at less than commercial size. I will also be discussing the need for prototype demonstration projects and the federal government's role in building such facilities.

Without a doubt before such facilities can be built in this country there must be an expanded and consistent Fossil Energy and Conservation Research Program in the Department of Energy (DOE). As a first step, the gas industry has recommended that a total of $108 million for gas-related research be included in the DOE fossil fuels budget and $22 million be included in the conservation research budget in FY 1985 to continue critical, long-term gas-related research programs. These budget recommendations are essentially the same as appropriated by Congress for FY 1984 and are in accord with the Administration's stated energy policy, complement the current research programs funded by the gas industry, and are consistent with the previous initiatives and leadership actions taken by this subcommittee and Congress to ensure a viable long-term gas research program in the Department of Energy. In this regard we wish to thank you Mr. Chairman and the Subcommittee for the support you have given the gas industry's program in these difficult budget times.

GRI is an independent, not-for-profit scientific research organization created by the gas industry in 1976 to plan, finance, and manage an expanded and fully coordinated gas-related research and development (R&D) program for the mutual benefit of the regulated gas industry and its ratepayers. GRI cofunds and coordinates many of its research programs with DOE; therefore, the actions of Congress on the FY 1985 DOE budget have a direct impact on the gas industry's research program. We have often presented testimony on the DOE budget before this Subcommittee. However, today I am presenting GRI's comments from the perspective of a research management organization that funds others to perform the actual research. GRI, over the past seven years, has been very successful in bringing new gas-related technologies to the marketplace through a full and equal partnership with industry. One cornerstone of this success has been a consistent GRI policy not to proceed beyond "proof-of-concept" without the involvement of an industrial partner who can bring the product to commercialization if the research is successful. This policy should also apply to DOE programs.

GRI fully supports the concept that the demonstration of emerging fossil energy and conservation technologies should be a major element of the research program of the federal government. Therefore, the DOE role in fossil energy R&D should have three components:

- Basic Research: Research at the laboratory scale to extend the basic knowledge of fossil fuels and to develop and train the future scientists necessary to advance the technology. This research is mostly conducted by the energy technology centers, national laboratories, and universities.

- Exploratory or Proof-of-Concept Phase Research: Research effort to test and evaluate the more promising concepts at the process development unit (PDU) scale. This should involve industry in the research.

- Large Pilot Plant or Demonstrations: Final step prior to industry applying financial incentives for initial commercialization. In this phase processes and components at a scale sufficient in size to easily extrapolate to a commercial module are tested for engineering design and economic evaluation. The actual size of the test facility will vary with the process but could range from 200 tons to 1,000 tons or equivalent per day. It is imperative at this phase to have significant industry cofunding and industry management of the daily construction and operation of the test facility.

Without all three components in the federal energy program, there can be no assurance that the taxpayer will actually receive benefit from the money expended in his or her behalf. Yet the present Administration has been opposed to the third and most crucial part of this process, the technoloical and economic demonstration of new conservation and fossil fuel technologies.

How to close the wide gap that exists between current DOE R&D policy for fossil fuels technologies and the financial authority of the SFC of commercial ventures is a major source of concern. Federal support of synfuels is currently bracketed by the DOE's support of basic research through proof-of-concept on one end and the provision of financial assistance to commercial projects that have been judged to be technologically and economically mature by the U.S. Synthetic Fuels Corporation at the other end. The recent legislation proposed by the Administration in the "Energy Security Reserve Amendments of 1984" would make this gap even worse due to the cutback in synthetic fuels funding. The gap would become wider instead of narrower. What is missing is the federal support for applied research and engineering necessary to demonstrate advanced fossil energy technologies and conservation projects at a scale necessary to extrapolate viable engineering design data and accurately determine process economics. We need to reexamine national energy policy to determine how advanced, more efficient and more economical synthetic fuels technologies can move from proof-of-concept to technological demonstrations. This "technology gap" impedes the ability of American industry to develop the advanced processes necessary to assure adequate supplies of energy in the future.

While the lack of support from the federal government to demonstrate these new technologies affects the conservation program as well as the fossil energy program at DOE, the results of such a "gap" are more readily seen in the demonstration of fossil energy technologies. My testimony will therefore focus on these fossil fuel technologies.

Rationale for Early Demonstration of Coal Conversion Technologies

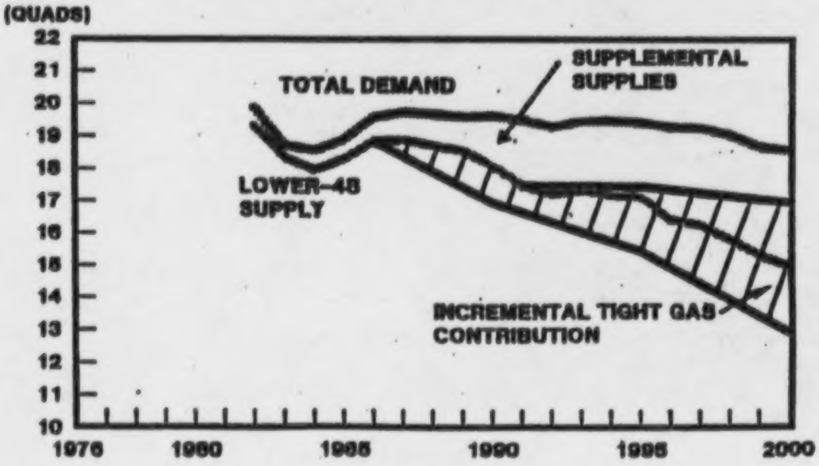
Before discussing my views on the "technology gap" and the need for federal support of technology demonstrations, I believe it would be useful to clearly understand the role that supplemental energy supplies will have in the United States through the early part of the 21st century. Gas from coal can be a very important form of supplemental supplies especially in the early part of the 21st century. There is wide agreement among both private and federal forecasts that the U.S. will continue to rely on traditional hydrocarbon resources, i.e. oil, gas and coal for over 70 percent of its energy needs in the year 2000. However it is clear that the source of supply for our future demand will either have to be from reserves other than the traditional reservoirs and formations, or that these resources will have to be produced in non-traditional ways.

Despite the whopping increases in crude oil prices during the 1970's, U.S. proved oil reserves have dropped by about 10 billion barrels since 1970, from nearly 40 billion barrels then to less than 30 billion now. In Texas, traditionally the nation's top producer, daily oil output has declined by about 700,000 barrels since 1977 to a current level of about 2.3 million barrels a day. At Alaska's North Slope, site of the greatest oil discovery in U.S. history 16 years ago, the main reservoir at Prudhoe Bay already shows signs of wear, and oil companies are now injecting water into the reservoir to push out more oil and maintain the flow. A growing portion of U.S. production--about one of every six barrels--now dribbles up out of stripper wells that produce on average less than three barrels a day.

While the U.S. has a short-term gas deliverability surplus now, more and more of the required gas supplies must come from supplemental sources by the year 2000, and immediately afterward. As can be seen from the chart below, natural gas production from the Lower-48 reserves will decline precipitously in the 1990s and significant supplemental gas supplies will be needed thereafter.

POTENTIAL ROLE OF

SUPPLEMENTAL SUPPLIES



Assuming current governmental policies and no cataclysmic world events which would significantly affect the cost and supply of world oil, the orderly introduction of supplemental supplies starting with the lowest-cost sources, in conjunction with Lower-48 production, has the capability to sustain the projected demand levels. The current excess deliverability from "conventional" domestic natural gas production, along with the under-utilized Canadian import potential, could defer any requirement for additional supplements beyond 1990. Accelerated development of tight formations gas and coal seam methane would give us further confidence in this predicition. However, after the year 2000, significant amounts of other supplemental sources will be required.

If our assumption of current government policies and world events holds true, then GRI projects that supplemental gas supplies may be used according to the following table.

1983 GRI Baseline Projection of Gas Supply and Price Trends

	1990		2000	
	Supply (Quads)	Acquisition Price[a] (1982$/MMBtu)	Supply (Quads)	Acquisition Price[a] (1982$/MMBtu)
Natural Gas[b]	16.9	3.68	14.0	5.74
ANGTS Gas	0.7	10.23	1.2	5.30
Pipeline Imports	1.5	3.72	1.8	5.69
LNG Imports	0.2	6.95	0.7	6.97
Coal Gas	0.1	10.10	0.3	8.40
SNG from Petroleum	0.1	6.96	0.2	8.48
Total Delivered	19.5	3.97	18.2	5.82
Unaccounted for Losses and Exports	0.6		0.6	
Total Supply	20.1		18.8	

---

[a] *Weighted average price at wellhead, border, or plant gate.*

[b] *Includes lower-48 conventional and unconventional gas.*

However, the question that we must be concerned with in this hearing is, "What do such predictions mean for the development of the technology associated with these supplemental energy supplies?"

Establishing the technology base to develop these supplemental supplies at cost-competitive prices requires a lead-time of 6 to 15 years, depending on the resource. In other words, we must start now. If we do not take the steps necessary to develop the technology base required to use these domestic resources efficiently, the level of oil imports will rise rapidly, again increasing our dependence on insecure oil from politically unstable regions. The current softness in the world oil markets and surplus gas deliverability provides us with the opportunity to pursue this critical technology development in an orderly fashion now rather than on a crash basis later.

But even though we all recognize there are long lead times involved and we have adopted a national policy to carefully and deliberately build prototype synthetic fuel plants to test the technology for supplemental energy supplies, there is an important part of the policy missing. The last critical link between research and commercialization, pilot or demonstration plant, is not there.

The Technology Gap Created by Federal Policy

The current federal research policy has created a "technology gap." The issue is how to build and demonstrate large-scale advanced coal conversion and utilization processes so that they will be available when needed to meet the demand for supplemental energy supplies. Currently, neither DOE nor the SFC supports this essential and risky step in technology development. I will focus on the effect of this gap on the ability of the regulated gas industry to develop and demonstrate new, improved technologies capable of gasifying eastern bituminous coals and coal fines associated with run-of-the-mine coal. However, it should be recognized that the problems and needs discussed are characteristic of the problems encountered by any synthetic fuels technology that has progressed to the point of proof-of-concept but is a very long way from commercialization.

As I discussed previously, GRI's current projections show a requirement for significant quantities of supplements to Lower-48 natural gas supplies beginning in the 1990s. After the year 2000, coal gasification could become an important option in meeting this demand. The nearly completed Great Plains coal gasification project will demonstrate the ability to successfully gasify western lignite coals. However, the technology utilized in this project does not readily gasify eastern bituminous coals and cannot handle the extensive quantities of coal fines generated during the mining and handling of coal. The development of an advanced gasifier is critical since the eastern coal fields are located near major industrial markets and in regions with abundant water resources, providing solutions to many of the objections to extensive development of synthetic fuels production in the West.

The gas industry has long been active in the initial development and financing of the research of technologies for the production of pipeline-quality gas by gasification of eastern coals. A joint Office of Coal Research/gas industry coal gasification program was started in 1971 and funded on a one-third industry, two-thirds DOE, cost-sharing basis. While a great deal of progress has been made, there currently is no advanced commercial process available for the high Btu gasification of eastern coals and fines. Significant additional development and demonstration of technology is still necessary before these coals can be economically utilized. In order for coal gasification to have a significant impact in the time frame required, we have to validate the needed economic and design data by the early 1990s.

In cooperation with the Department of Energy, the gas industry and others over the past ten years have vigorously pursued the development of advanced coal gasification technology. The projects sponsored varied from the pursuit of new ideas in the laboratory to process development units to pilot plants to demonstration plants. Attention was given to each of the essential links in the technology development chain. With the election of President Reagan, the philosophy of the government's role in energy shifted radically. In place of the aggressive federal role in research, development and demonstration, the

Administration determined that "the Federal government . . . will focus its support on that longer-term, high-risk research and development that industry has generally been less willing to undertake. Once the conceptual hurdles have been surmounted, the final scale-up and deployment of a new technology will be the responsibility of industry." In earlier testimony before Congress, Assistant Secretary for Fossil Energy William A. Vaughn made it very clear that "the FY 1985 Fossil Energy budget request continues to emphasize generic or cross-cutting research that is unlikely to result in company-specific proprietary knowledge. It continues to focus the federal role on the early stages of research and development, i.e., basic and applied research through the technical proof-of-concept . . . which are not likely to attract substantial private sector support without federal involvement . . . ."

While the DOE role is being limited to basic research and very small scale proof-of-concept tests, the role of the Synthetic Fuels Corporation is limited to the financing of commercial ventures utilizing mature technology. It has no responsibility for research and development, which is appropriate considering the solely financial character of the SFC. Its priority is to sponsor projects with low technical risk and high promise of ample production, which will demonstrate a broad spectrum of resources and conversion technologies. Before the SFC will begin negotiating an agreement for financial assistance, it requires each proposal to pass a series of tests to show that it is technically and economically viable with demonstrable markets.

In implementing its policy, the Administration has created a serious "technology gap" in the development chain. As Assistant Secretary Jan Mares testified last October: ". . . the Department's current R&D program does not entail 'process development.'" The process development stage is perhaps the most crucial stage in the development of a new technology. It is during this stage that a good technical idea is turned into a process with commercial potential. Mr. Mares correctly noted that "for most (but not all) synthetic fuel technologies, this stage of development is characterized by large pilot plants--100 to 200 tons per day." However, the construction of a pilot plant is normally preceded by the construction and lengthy operation of a smaller scale process development unit. Both of these are essential parts of the process development chain. Neither can be skipped.

In testimony last fall, the Administration acknowledged the "gap between the assistance available from DOE for laboratory research and from the SFC for commercial-sized synfuel plants," but dismissed the significance of the gap by stating that "to date, no new synfuels concept in the Federal program is technologically ready for the process development stage. Therefore, at the present time, no technology is being hindered from moving into larger-scale development and commercialization." In fact, there are a variety of processes whose development has been hindered by the gap in the federal research and development chain. For example, DOE has requested no funds for the development of the agglomerating ash fluidized bed process at Waltz Mill, Pennsylvania, that has been cofunded by DOE, Westinghouse, and the Gas Research Institute. DOE has also eliminated its pilot plant program and cancelled its synthetic fuels demonstration program. The Administration's assertion that none of its new technologies are ready for larger-scale development is, therefore, self-fulfilling.

In his testimony last October, Mr. Mares indicated that the Administration was willing to reassess the federal role for process development "if problems do arise in the future regarding the capability of the private sector to move emerging technologies through the large-scale process development stage." Technologies are being impacted and the Administration should carefully reexamine its policy.

Most recently Assistant Secretary Vaughn testified, "In addition, our policy of encouraging significant cost sharing as a prerequisite for consideration of larger-scale development efforts should provide industry with a clearer signal of the requirements necessary for Federal support of projects that are beyond the laboratory and bench-scale development stages." In paraphrasing their own testimony, DOE went further and said, "The door is open and the phone is on the hook." While this may appear to open the door to negotiations with the DOE along the lines we have recommended, nowhere does DOE indicate that they would be willing or able to sign agreements for such demonstration plants. Nor have they requested funding which would make such negotiations meaningful.

In reexamining this demonstration program concept, Congress and the Administration should not be tied to following the very expensive practice of building stand-alone plants, as was assumed in the past. I suggest that the Administration consider developing and demonstrating advanced processes at existing commercial synthetic fuel plants where most of the necessary components and required services are already in place. This would allow advanced technologies in the process development stage to be developed and demonstrated faster and cheaper than building temporary stand-alone plants. For instance, it would make sense to examine operating a new, more advanced gasifier at Great Plains where all of the coal handling and downstream equipment are already in place rather than replicating these same components for a stand-alone plant.

The Congress should also consider requiring the SFC to allow for slip-stream testing of advanced processes at the commercial plant sites as a condition of funding proposals. The SFC should require that all awards provide for the opportunity to test advanced technologies.

Above all, the Congress should encourage DOE, either through new legislation or by exercising its present authority, to provide for the construction of facilities such that the components can be tested at sufficient size to allow for further scaling with a high degree of confidence. Depending on the status of development, this could range from pilot plants operating with gasifiers at reduced scale to tests of a single commercial scale gasifier operating at an existing facility to the construction of a multigasifier demonstration plant similar to those that were designed with ERDA and DOE funds but never constructed.

While I support the funding of basic research, it is difficult to see how an improved synthetic fuel technology could come out of the Fossil Energy program if this is the only research phase supported by DOE. Private industry will not be able to assume the technical and financial risk alone to bridge this gap between DOE's research program and the commercialization effort of the SFC.

Furthermore, the federal cost of any demonstration program can be successfully reduced by requiring meaningful cost sharing with the industrial participants. I do agree with the Administration that "the amount of private sector cost-sharing is an important indication of a new concept's technical validity and commercial potential." I also concur that "as new technical concepts mature and move along the development path, industry is expected to assume a greater cost-sharing role." It is appropriate for DOE to require significant cofunding by industry before funding the development of any technology at the large pilot plant scale. However, in exchange for this cofunding, DOE should delegate management of the construction and operation to the industrial partner. A perfect example of such an approach in the past was the Exxon Donor Solvent plant, which was funded on a 50/50 full cost-shared basis. That plant entered production on schedule and on budget, and successfully accomplished the goals of its program. This federal cost-shared approach should provide industry with the stable and consistent financial support it needs to develop advanced synthetic fuel process.

Comments on Proposed Legislation

We understand that the subcommittee has under consideration four bills which would encourage the research, development and demonstration of coal conversion technologies. We were asked to comment upon this legislation as part of our testimony. The four bills are HR 4182 by Congressman Rahall, introduced October 20, 1983; HR 5044 by Congressman Walgren, introduced March 6, 1984; HR 5592 by Congresswoman Lloyd, introduced March 3, 1984; and HR 5593, also introduced by Congresswoman Lloyd on the same date.

The first two bills, HR 4182 and HR 5044 are similar, and establish a comprehensive three part coal research program. Both bills will require the construction or retrofit of 12 to 13 demonstration plants within five years of enactment, with the technologies to be demonstrated specified in the bill. The Department of Energy will be able to use all presently available forms of assistance in the Rahall bill, but they are limited to grants under the Walgren bill. The authorization, $775 million, is identical for both bills.

The two bills introduced by Congresswoman Lloyd are identical except for the source of funding. In both bills DOE is required to solicit proposals to demonstrate specified coal conversion and utilization technologies which will provide more efficient ways of utilizing coal in a more environmentally acceptable manner. While many of the technologies to be demonstrated are specified in the bill, DOE is given latitude to seek other technologies for the utilization of coal in a more environmentally acceptable manner and for the extraction of oil and gas from coal and shale. All demonstration plants or retrofits are to be sited in electric power plants. Both bills provide for an authorization of $200 million for 1986. HR 5592 provides for an authorization of such sums as may be appropriated thereafter, while HR 5593 provides for a transfer of $1.85 billion from existing SFC authority to fund the entire program.

We think that the concept embodied in these bills, i.e. the technological demonstration of coal conversion and utilization technologies with the sponsorship of the DOE, is in the national interest and should be supported by the subcommittee. However, we would urge the subcommittee to avoid specifying the technologies to be demonstrated. Congress should not attempt to perform DOE's and industry's duties. Instead, Congress should insist that DOE prepare a detailed five-year technology demonstration plan for fossil energy to be submitted to Congress; the plan should include input from industry. Similarly, Congress should not mandate that a particular location be used for construction of these technology demonstration. Siting such demonstrations or retrofits exclusively at electric power generation plants may or may not result in the best demonstration or the least cost to the taxpayer. It is difficult to imagine an electric power plant site that would be appropriate for the demonstration of shale conversion technologies, for example. DOE and industry should be free to examine all valid options and report to the Congress on its findings.

We also urge the Committee not to exclude from legislation the demonstration of extraction technologies for gas from coal or shale; H.R. 5592 and H.R. 5593 both provide for this. Gas is a natural coproduct in coal mines, especially in the eastern part of the United States. Production and sale of this gas will improve the economics of any project and also improve the safety for the miners operating in underground coal mines. Unmineable coal seams distributed throughout the United States represent a significant potential source of natural gas. Although commercial production of coal bed methane has begun in some areas, economical recovery of a large portion of the resource is currently restricted by the limitations or unproved effectiveness of conventional drilling, well-completion, stimulation, and de-watering techniques. GRI is seeking solutions to the problems of formation damage and the ineffectiveness of stimulating coal seams deeper than 3000 feet in an experiment in the western part of the United States in Colorado's Piceance Basin. A complementary project is being conducted in the east in the Warrior Basin of Alabama to address the many overlying coal seams which are presently individually unattractive for development. Finally, GRI is sponsoring the development of fracturing and reservoir modeling techniques especially suitable for coal bed reservoirs which will help to increase production from both deep and multiple seams.

GRI is not now recommending federally funded technology demonstrations of coal seam methane extraction. Rather, we recommend that the Congress not ignore the fact that gas is produced along with coal and can contribute significantly toward improving the economics and the safety of operations of any coal extraction operation associated with the coal conversion and utilization technology demonstrations under consideration. Where the opportunity presents itself, DOE should have the flexibility to consider a proposal for a coal conversion or utilization technology with a coal bed methane extraction operation.

In any legislation to establish a demonstration program, we would encourage this Subcommittee to heed the lessons of the prior coal demonstration program conducted by DOE. We recommend that all industrial participants be required to contribute a significant percentage of the total cost of any technology demonstration project cofunded with DOE, and that the total costs of any project should be fully understood by the Congress, DOE and industry before any project is authorized.

Finally, while Congress is contemplating a new coal demonstration program for DOE we would like to point out that any change to the authority or program of the Synthetic Fuels Corporation which would result in the abandonment of the Great Plains Coal Gasification Plant before operation, could significantly affect the gas industry's coal gasification program. If the letter of intent to the Great Plains Associates is not finalized as an award, and the sponsors do abandon the project, GRI would have to reconsider its existing advanced coal gasification technology program. The lack of information concerning operation of a commercial coal gasification plant would create a large void in the data base needed to demonstrate advanced coal gasificaiton technologies.

Recommendations for a Joint Federal/Industry Technology Demonstration Program

By way of conclusion I would like to make the following points regarding any joint federal/industry program to demonstrate new coal conversion and utilization technologies. I would like to point out that these recommendations are made from our organizational experience in funding technology demonstrations successfully. In all of our efforts we have found that a true market approach which involves an industrial partner in all stages of development and demonstration beyond proof-of-concept is a critical ingredient to success. We believe that the 13 new gas industry products which we have sponsored and which are now commercially available and in use, have taught us a great deal about the need for a coordinated, cost-conscious approach to technology demonstration.

1) The Congress should recognize that DOE has a clear role in demonstrating new coal conversion and utilization technologies, and technologies which improve the efficiency of utilization, because of the fact that industry will be unable to support these very expensive and highly risky technology demonstrations alone. As I have discussed before, there is a clear need for the federal government to continue the natural progression of development for a new technology from the laboratory and proof-of-concept stage through the technology demonstration phase. Without the federal government's presence in this last step, much knowledge will be accumulated, but no further benefits will result from the expenditure of taxpayer money since there will be no commercialization.

2) The federal government must accept the industrial cosponsor as a full partner in the demonstration of a synthetic fuels process even when the federal government is a major source of funds. Both the industrial participant and the government must bring assets to the table for the project to be successful.

3) The private partner should be responsible for providing a significant portion of the construction and operation costs. Some of the cost-sharing by the private partner should be in the form of actual funding, rather than in the form of credits for past research or promises of future payments from the product of the plant. By requiring the industrial partner to bear a substantial risk, the government can expect the private partner to utilize its full capabilities in designing, constructing and operating a successful facility. In addition, the cost-sharing requirement will encourage the private partner to design a plant at the smallest feasible scale. At the same time, the private partner will make sure the plant is of adequate size to gather the necessary data due to the industrial sponsor's sizeable investment. This only makes sense for the private partner to be responsible for selecting the process, site, size, energy source, management and end-product for the project.

4) Since the federal government should be providing a minimum of 50 percent of the funds for any project, the Congress and the Executive Branch should take several steps to ensure that the project operates in an environment which will minimize cost overruns through proper management. The first step is to develop total program costs for these major energy projects and include these careful estimates in the federal budget. This will allow Congress to debate the merits of projects with the full knowledge of future budget requirements. The second step is to provide for a single authorization for the design, construction and operation for a plant once the Congress has decided to proceed with the project. The third step is for the Congress to provide for multi-year appropriations to allow for proper program planning. The construction schedule should determine the pace of the project rather than the uncertain schedule of the annual authorization and appropriation process.

5) The executive branch should leave the day to day management of the project to the industrial partner. The government must not attempt to take away the management prerogatives of the organization that must commercialize the technology. During the 1970s, DOE experimented with a contracting approach that could serve as a model for future efforts to demonstrate synthetic fuel technology. In exchange for contributing 50 percent of the cost, Exxon was given day to day management control of the Donor Solvent pilot plant. Conducting this project under a cooperative agreement proved very successful. Exxon was able to construct the pilot plant essentially on time and on budget.

The Synthetic Fuels Corporation Act incorporated a sound philosophy on the role of the SFC program managers that should be adopted by DOE. The SFC participation is "limited to financial participation only and shall not include any direct role in the construction or operation of the module." Even in the case of direct funding by the SFC, the Act makes clear that "In no event...shall the persons in the joint venture agreement be denied the primary responsibility for management of the joint venture."

6) In passing legislation, the Congress should not specify which technologies are to be demonstrated, nor the size of the demonstration. Similarly, Congress should not seek to specify the site of a demonstration, prior to serious consultation between DOE and whichever industrial firm is interested in the technology demonstration.

7) In determining which proposals to select it should be recognized that a stand alone plant will usually be the most expensive type of technology demonstration, and therefore should only be considered as a last resort. Our experience has shown that proposals which rely upon the use of existing utilities at the site, e.g., existing oxygen plant, electricity, water, coal supply, etc., will almost invariably result in a lower overall cost with little or no adverse effect upon the goals of the technology demonstration project.

In conclusion, the current federal energy research policy has created a "technology gap" for nonnuclear research and there is a need for a viable federal role in the applied and engineering research phases of coal conversion and utilization processes. Without this federal support, the timely development of advanced processes to use the nation's vast coal resources in an environmentally acceptable manner will be seriously delayed. A joint DOE/industry program is needed now.

Mr. Chairman, this completes my testimony, and I will be happy to respond to any questions.

Mr. **Boucher**. We presently have a call at the House, and we have about 10 minutes remaining to record our votes. We are going to do that at the moment, so I will recess the subcommittee temporarily. We'll reconvene in 15 minutes and at that time we will have questions for both of you.

[Short recess taken.]

Mr. **Fuqua**. The subcommittee will resume.

Mr. Spencer, have you tried to work out—and maybe both of you—work out whether Department of Energy on any kind of a formal basis or method, to establish possible needs for demonstration scale facilities, or maybe proof-of-concept, as we got into this morning? And I guess that it depends on the definition that anybody applies, but I guess we're talking about beyond just the research and development stage where we try to understand if it will work or not work.

Mr. **Spencer**. Well, in answer to your question, Mr. Fuqua, we have not formally tried to sit down with DOE and identify or lay out a program with them recently. A number of years ago we did have such discussions as to which technologies we thought were about ready to move into demonstration scale facilities.

I would like to differentiate between proof-of-concept, if I could, and what I would call full-scale commercial modules, as being a good way to look at things, I believe.

In proof-of-concept, generally we would say that in the case of coal, that one can prove that at the nominal, 100 ton to 200 ton per day capacity facility—similar to the Obernhausen-Texaco unit, similar to the TVA-Texaco unit, and so forth. But when you talk in terms of full scale module operation, you're in the 800 ton to 1,200 ton per day capacity range. So you've changed the project size by about a factor of 5 to 7 in our judgement, in order to clearly identify the operating capabilities of a system that might then be a part of a commercial plant subsequently.

We would be delighted to meet with Assistant Secretary Vaughan and others to discuss what we think are meaningful candidates, some of which were considered by DOE a number of years ago and have subsequently gone by the wayside.

Mr. **Fuqua**. So you think there can be a definition? As I recall, Assistant Secretary Vaughan was saying it would have to be done on an individual basis, that some may require longer periods of time—he used the illustration of MHD, which is a little different technology than just the general coal technology that we perceive. But you think a handle of around 200 tons per day capacity would be a demonstration, semiworks, or proof-of-concept?

Mr. **Spencer**. Well, I'd call that a proof-of-concept. The semiworks scale, I'd say that's more of a 1,000 tons per day capacity, to differentiate the two. But if you look at the H-Coal pilot plant, it was about 200 tons per day. The EDS pilot plant, about 250. The two gasification—actually, the CDIF isn't really that different. It's rated at 50 megawatts thermal and if you convert that over, that turns out also to be in the neighborhood of 150 tons per day capacity. So that's what I'd call the proof-of-concept scale.

And then we have this next scale up, like the Cool Water size at 1,000 tons per day, which is the key step before we're going to be able to judge the commercial viability.

Mr. **Fuqua**. Dave, would you care to comment?

Mr. **Webb**. Yes, Mr. Chairman. After Assistant Secretary Vaughan's testimony a couple of months ago about how DOE was willing to discuss where we perceived there was a need to look at some way to cofund or to build some of these facilities, we have started discussions with people in his Department on perhaps trying to take an advanced gasification process and test the gasifier and a little bit of the downstream equipment at commercial scale at the Great Plains facility. Now, that is very complicated because, No. 1, it's not clear whether the Great Plains facility will go ahead due to the uncertain status of the Synthetic Fuel Corporation; and No. 2, we have to negotiate with Great Plains to be sure that they would not object to us trying to do that at that site.

My impression, though, is that the Great Plains people have certainly been encouraging. It would appear to us that for somewhere in the area of $100 million to $130 million or $140 million over 7 or 8 years, we could put together a program that would really test the gasifier, at least, at commercial scale of the advanced fluidized bed gasification system, perhaps some advanced cleanup systems, some downstream processing. So we have done that.

We have also recently started discussions on trying to structure a long-range program in gas-fired heat pumps with Department of Energy, but that's not nearly as far along in the process, Mr. Chairman.

Mr. **Fuqua**. In your testimony you mentioned about the Great Plains; you just referred to it there. If it's not given some additional financial assistance, I think you said you'd have to reassess GRI's participation in that technology program. What kind of magnitude of the program and the technology do you consider to be involved in this?

Mr. **Webb**. Well, if the Great Plans facility is constructed and operated as planned, and assuming we were successful in striking a program with DOE and the Great Plains and some gas utilities to run tests at a slip-stream site there at the facility, then we're talking about probably $7 million or $8 million a year from GRI and a like amount of money from DOE, and then maybe half of that amount from some equipment manufacturers and the gas industry to do a very meaningful program. Without that facility and that site, then that cost is maybe $300 million or $400 million and it's a whole different magnitude of problem. We haven't really sat down and tried to figure that out, Mr. Chairman.

Mr. **Fuqua**. Mr. Spencer, you mentioned—and Congressman Boucher referred to it, and you did in your opening statement—about the involvement of the Government over a certain period of time before industry could participate and so forth and make significant investments in new technologies. How would you propose, if we were to pass legislation setting up a demonstration scale activity—what are some of the general requirements that you think should be included in that? Some of the bills that were testified to yesterday by Mrs. Lloyd; also by Congressman Walgren, and there may be other bills, too, pending along those lines.

Mr. **Spencer**. I'm familiar with some of the bills that are being considered in the Senate, Mr. Fuqua.

I would say that our recommendation would be similar to GRI and what I've said in my testimony, and that is that we ask the private sector to come forward with their recommended demonstration facilities, with the capital and their portion of the operating cost subsidies well defined, to the Department of Energy on a project-by-project basis; and to hopefully jointly, among the private sector developer, EPRI, or GRI, and the Government, decide which of these really merit support.

I did not include a cost estimate in my formal testimony of these demonstrations but I have given it some thought. I'd like to offer this to you just for your own appraisal. But if we were to undertake essentially the entire program that we see as possible and reasonable from a technical viability standpoint in the next 5 years, it would range, I believe, between $2 billion and $4 billion total cost—that would be capitalization and operating cost subsidies—for some approximately 10 plants; so we would be looking at a Government role of someplace in the neighborhood of $1 billion to $2 billion over a 5-year period of time.

I think that is a level which is commensurate with a rather aggressive demonstration program and at the same time it does not escalate requirements to the degree that at one time the DOE project was set at. So that is my best estimate.

As far as other aspects, I would like to reiterate that I really believe we should maintain the proprietary rights in the private sector because I think what we're trying to establish is a business environment at the same time that will really make these systems take the next step beyond that, of our full-scale commercial modules and really make them commercially viable.

Mr. **Fuqua**. You outlined in the latter part of your prepared testimony several different technologies and projects. How would you prioritize those?

Mr. **Spencer**. Well, I have not tried to do that on a one, two, three basis, but I would say that where we stand today, at least in EPRI's judgment, is that the IGCC technology and AFBC technologies are the two foremost opportunities for clean coal utilization in the 1990's, so that the three demonstration projects in AFBC, the Cool Water project which we already have funded, and then I would say at least one, if not two, of the other gasification technologies, BGC and Shell, would be very high on my priority list.

So I would say those—the three AFBC technologies and three gasification demonstrations would give us a very good stable of advanced coal utilization systems.

In a shorter term, I think we do need some demonstration work on coal-water slurries at full scale in boilers to make sure that we are satisfied that they can substitute for oil; and then finally, the environmental systems that are being proposed like the advanced dry scrubber and dry alkali addition systems.

So if you look at those coal systems, perhaps a billion dollar total effort over the next 3 to 5 years, I think, would allow us to demonstrate that stable of technologies.

Mr. **Fuqua**. You mentioned advanced scrubbers. Do you think in the long run, with the fluidized bed and some of the other coal cleaning technologies, that scrubbers will be necessary in the long run?

Mr. **Spencer**. I don't believe they will be necessary in the long run, and they certainly are not the choice of the power industry. However, as you well know, legislation may be enacted which requires retrofit of existing plants, and it's most likely in my judgment if the retrofit requirement is levied on the electric power industry, that they will have to turn to scrubber technology rather than front end prepreparation technology. As a consequence of that I think we need the scrubber capability as essentially a contingency plan against that eventuality.

Mr. **Fuqua**. David, the Department of Energy has stated that it is not their policy to fund pilot or "semiworks" facilities. Is there any facilities currently being considered that are affected by this policy?

Mr. **Webb**. Mr. Chairman, I'm not sure. You're talking about programs that GRI would go forward with?

Mr. **Fuqua**. Yes.

Mr. **Webb**. Well, there are a couple that, if that were not their policy, we certainly would be having serious discussions with them then. One would be in the fuel cell program.

I think there's a misunderstanding. We have put in twice as much money as the Department of Energy in field testing and developing these 40 KW fuel cell systems. We know that the next phase is somewhere in the 200 to 400 kilowatt range before we can actually get into commercial operation. I think somewhere a very limited number of those needs to be built and run so the utilities, in fact, have confidence in those systems; because to get this process commercialized—and it looks very promising; we've had very good results——

Mr. **Fuqua**. Is that in your 40 KW?

Mr. **Webb**. It would be the final phase between the "proof of concept," if you would, or the pilot plant phase of the 40 KW and commercialization. It would be a limited number, 8 or 10 of the 200 KW sites; because when you get ready to commercialize it, the manufacturer, United Technology or whatever entity they set up is going to put in a couple of hundred million dollars to build a production line, and the gas utility industry is going to have to come up with guaranteed commitments to take delivery on enough of those systems that we're talking about another $500 million. The utility sector, both electric and gas, are very conservative before they make these types of investments; and the fact that it—it looks like we're going to be successful on the 40 KW size. They are up and running at 13 sites now. Some of the initial problems that we were experiencing, we're beginning to understand much better and one of the systems has actually run for about 160 continuous days now. So we're very encouraged.

But there would be a logical next step if their policy were not that they wouldn't do these types of demonstrations; it would be to sit down and work up a reasonable program in the 1986–1988 time frame to build a limited number of these plants and put them out in the field and let them run, fully recognizing that from that step forward it is up to the industry and the manufacturer to commercialize this technology. That's probably the most critical one.

Another one that will be coming up in 2 or 3 years, though, is going to be the heat pump. Again, you're talking about a very sophisticated technology where we're working with DOE now on developing the components, if you would, of the system. But under the current DOE policy they'll be very reluctant to go into what we would call field tests—or, if you would, technology demonstrations—of a limited number of the units to determine a lot of things about the economic servability, warranty programs, things like that, Mr. Chairman.

Mr. FUQUA. Mr. Boucher?

Mr. BOUCHER. Thank you, Mr. Chairman.

Mr. Spencer, I was very interested in your testimony where you stated that demonstration scale projects on coal-water mixtures would be appropriate.

First of all, I gather from that remark that there are no demonstration scale projects for coal-water mixtures at the present time. Is that correct?

Mr. SPENCER. There are no commitments for that. There have been a number of planning studies done by the utilities as well as suppliers, but they have not really put the two together at this point.

Mr. BOUCHER. Where would you envision such a project being installed? Would it be at a utility site, and how would you envision that being financed? Would it be through a combination of private utilities plus Government participation, or would you perhaps see a coal company being involved in that?

Mr. SPENCER. Well, I think we need to separate the two aspects. One would be the production of the coal-water slurries themselves, and secondly then, the utilization of that fuel once it's made.

I'm more familiar with the utilization end of things because we work closely with Florida Power & Light and New England Electric Systems and some of those utilities who are seriously interested in assessing the suitability of those fuels. In that case, it would clearly be a joint funding arrangement between the electric utility, perhaps and the Synthetic Fuels Corporation; or if that does not materialize—as you know, they have a solicitation from the Synthetic Fuels Corporation on coal-water slurry demonstrations—so if that were to materialize, that would be one method of seeing that such test burns take place. If it does not materialize, we do not see a mechanism.

On the production end, in the case of where they would be done, in the case of Florida they have selected one of their 200 megawatt scale oil-fired boilers—I've forgotten exactly which unit it is at this point—which would be the candidate for retrofit of coal-water slurry, so that that would be a site in northern Florida. I don't believe it's in your district, Mr. Fuqua, but not too far away; I think around Jacksonville.

And then the second aspect would be where the production facility would be, and I think generally the utility view is that they would prefer to buy fuel across the fence, so to speak, just as they buy petroleum fuel and gas now; so that, assuming that the fuel supplier had a mechanism for transporting from his production facility to the test site—and in this particular site, I know that in Florida it can be served by barge—that there would be no reason to necessarily have the production facility of the coal-water slurry in conjunction with the actual boiler.

Mr. **Boucher**. So if I understand what you're saying, you're suggesting that the coal-water slurry would be manufactured, perhaps by the coal company, and then transported as a slurry to the utility?

Mr. **Spencer**. Correct.

Mr. **Boucher**. Why do it that way? Wouldn't it be a whole lot cheaper, long-term, to have the utility simply purchase the raw coal and create the slurry on site at the utility? That way you're not paying for the transportation of water.

Mr. **Spencer**. Well, the costs of transporting coal-water slurries do not appear to be significantly greater, as I understand it, than what we would have in the way of bringing the coal to the site and then going through the slurrying operation. You are correct, however, that utility financing of the capital for the slurrying operation generally would allow the fuel to be of lower cost than it would be if it were owned by a private sector firm, seeking a higher return on investment. But at this point, as I've indicated, at least, the preferences which I have heard from our utility constituency indicate that they prefer to buy the fuel across the fence rather than to own those production facilities.

In the case of Cool Water, which is an IGCC plant, however, fed with coal-water slurries, we do have coal in coal silos and we do actually do the grinding and coal slurrying operation on site, and that is capitalized as part of the project.

So, either alternative is a possibility.

Mr. **Boucher**. The demonstration project that is being contemplated for Florida Light & Power would involve the coal-water slurry being made by the coal producer rather than the coal user; is that correct?

Mr. **Spencer**. That's correct. That's what they envision.

Mr. **Boucher**. OK.

We've heard testimony for the last 2 days—well, principally yesterday—to the effect that it would be appropriate at this time to provide the Department of Energy with some additional funding with which to construct, in partnership with private industry, demonstration facilities, and that, perhaps, some of the budget authority presently provided to the Synthetic Fuels Corporation might be used for that purpose. Does EPRI have a comment on that? What is your view with regard to that proposal?

Mr. **Spencer**. I would like to comment a little circuitously, and the reason for that is very simply that I fundamentally continue to believe that the Synthetic Fuels Corporation has an important role in bringing about the first commercial systems of a particular technology, even beyond the so-called full-scale demonstration that we are talking about here. So I would not like to consider diluting what I continue to believe is in the national interests at the next step, because there are still financial risks and technical risks even after we run, say, a Cool Water scale facility for a few years. When you go to the first commitments at a few hundred megawatts, there will still be significant risk; and I think that's where the SFC should step in. It may be that we, unfortunately, if I may say it, put the horse before the cart. We have the capability of funding commercial plants, but we don't have the technology base to draw on. And I think that's what we've learned, unfortunately, in the last few years.

Mr. BOUCHER. I gather that your position is that you need Government assistance and that you'll leave, perhaps to us, the decision as to whether that assistance is provided through the Synthetic Fuels Corporation or through the Department of Energy?

Mr. SPENCER. Absolutely.

Mr. BOUCHER. I notice in your testimony you indicate that electric utilities are not likely to make substantial investments in new technologies until those technologies have been experienced on a full-scale basis for about 6 months, in the case of the smaller plants, and for 2 to 5 years in the case of the larger plants. Do you believe that the utilities are in a position today to supply the financing necessary to give you that 6 months' experience in one case, and 2 to 5 years' experience in the other?

Mr. SPENCER. Well, on a very selective basis, the answer is yes, because we do have the Cool Water project; we do have the Heber project, each of which did involve some Government subsidy—a price guarantee in the case of Cool Water, and in the case of Heber, a direct capital outlay by DOE. So the utility industry through EPRI, I think, is convinced that they are prepared to invest significantly in demonstration scale facilities, but it's not likely that we can carry the costs of those facilities alone, nor find enough private sector partners with us to carry them out without some Federal Government support.

Presently, EPRI's plan for the next 5 years calls for about $750 million in the coal conversion and coal control technology areas, that is available for development in large-scale demonstration. And, I think coupling that capability to a Government funding capability and the rest of private industry gives us a lot of leverage together to bring about these technologies.

Mr. BOUCHER. I know you heard Secretary Vaughan testify that in the conclusion of the Department of Energy, there is no technology gap between research and commercialization in which Government participation would be appropriate. I take it your view is that there is such a technology gap, that the electric utilities are not presently prepared solely with their own financing to construct the demonstration facilities, and that for that reason Government financing is appropriate, either wholly or in partnership with you.

Mr. SPENCER. I wouldn't want to say wholly. I do think it should be in partnership, whether it be the gas industry or the electric utility industry, but unequivocally I will say that there is clearly a technical gap that has to be filled by large-scale demonstration facilities. I don't care what we call them, but full-scale commercial modules is what I prefer to call them. And, as a consequence, we've learned just in the month at Cool Water that we've had to change the operating sequence significantly; we've had to alter maintenance practices, and we've learned a great deal relative to how you monitor and measure the performance of the system. And there is just no way that utilities are going to, in my judgment, commit multihundreds of millions to billions of dollars for new plants based on their past experience without having that scale of operation.

Mr. **Boucher**. Thank you very much, Mr. Spencer. That concludes my questions.

Thank you, Mr. Chairman.

Mr. **Fuqua**. Thank you, Mr. Boucher and Mr. Spencer and Mr. Webb. We appreciate you being here this morning, and your testimony and response to questions has been very helpful.

We may have other written questions we may want to submit to you for more specific answers and if you will respond as you have in the past, we would appreciate it.

The subcommittee will recess until June 13 at 9:30 a.m. when we will resume the further hearings on the matter of renewable resources.

[Whereupon, at 11:40 a.m., the subcommittee recessed, to reconvene at 9:30 a.m. June 13, 1984.]

THE STATUS OF SYNTHETIC FUELS AND COST-SHARED ENERGY R&D FACILITIES

WEDNESDAY, JUNE 13, 1984

House of Representatives,
Committee on Science and Technology,
Subcommittee on Energy Development and Applications,
Washington, DC.

The subcommittee met, pursuant to call, at 9:30 a.m., in room 2318, Rayburn House Office Building, Hon. Don Fuqua (chairman of the subcommittee) presiding.

Mr. Fuqua. The subcommittee will come to order and, without objection, permission will be granted for recordings and photographs during the course of the proceedings today. And following my statement, start an insert statement of Mr. Winn's for the record.

Today's hearings will complete our hearings on "Cost-Shared Energy Technology Projects and Facilities." We will examine the need for cost-shared demonstrations in the Department of Energy's conservation and renewable energy R&D programs.

We have received a great deal of testimony in the past few years about the potential for conservation and renewable energy technologies in the Nation's economy. We have also heard a great deal about the problems industry is having commercializing products in these areas.

As in the fossil energy area, Congress has seen fit to fund several of these technologies even though the administration's policies oppose such funding. The Sacramento Utility District photovoltaics facility, MOD 5 large-scale wind turbine, the pilot scale development of strip-casting of steel, and this committee's biomass gasification initiatives are such examples.

The stagnation of energy prices, uncertainty over the continuation of tax credits, and the effects of the recent recession have combined to increase the reluctance of industry to invest in risky advanced technologies.

On that basis, it appears that Federal cost-sharing on private sector demonstrations may be needed in the conservation and renewable energy areas to move these technologies to commercial status. That is what we seek to determine at today's hearings.

We have us—with us three experts in those areas: Mr. Pat Collins, the Under Secretary of Energy at DOE; Dr. Maxine Savitz, former Deputy Assistant Secretary for Conservation; and Dr. Ian Straughan, Director of Research for Southern California Edison.

And we will begin today with Mr. Collins. I notice that you are accompanied by some very outstanding individuals from the Department of Energy, Mr. Collins.

[The prepared statement of Mr. Winn follows:]

STATEMENT BY HON. LARRY WINN, JR., COST-SHARED ENERGY TECHNOLOGY FACILITIES AND PROJECTS HEARING, JUNE 13, 1984

Thank you, Mr. Chairman, for this opportunity to welcome our witnesses. We are pleased to have my old friend Pat Collins, Under Secretary at the U.S. Department of Energy, along with Dr. Maxine Savitz and Dr. Ian Straughan. This is our third in a series of hearings on cost-shared energy technology facilities and projects. To date we have heard from the Synthetics Fuels Corporation, the U.S. Department of Energy and two energy institutes. Generally, they addressed the fossil energy issue. Today we will receive testimony on conservation and renewable technologies.

In an earlier statement, I listed the generally-recognized steps for taking technology to maturity. In a review of the material submitted by our witnesses for the hearing today, it is noted that little or no recognition is given to the pilot plant or semi-works plant step. I recognize that these terms do become mis-used, as do any other terms generally used in any evolutionary process. One of the goals we could obtain from these hearings is a clear understanding, at least among ourselves, as to what these various technology development steps mean and generally what they include.

Mr. Chairman, these hearings should prove very helpful to the Committee as we review authorization requests and as we provide necessary oversight to ongoing projects and programs.

STATEMENT OF HON. PAT COLLINS, UNDER SECRETARY AND ACTING ASSISTANT SECRETARY FOR CONSERVATION AND RENEWABLES, DEPARTMENT OF ENERGY, WASHINGTON, DC, ACCOMPANIED BY DONNA FITZPATRICK, PRINCIPAL DEPUTY ASSISTANT SECRETARY FOR CONSERVATION AND RENEWABLES, DEPARTMENT OF ENERGY; ROBERT SAN MARTIN, DEPUTY ASSISTANT SECRETARY FOR RENEWABLE ENERGY, DEPARTMENT OF ENERGY; AND ALAN J. STREB, DEPUTY ASSISTANT SECRETARY FOR CONSERVATION, DEPARTMENT OF ENERGY

Mr. COLLINS. Thank you very much, Mr. Chairman.

I would like to take the opportunity to introduce my colleagues: Donna Fitzpatrick, the Principal Deputy Assistant Secretary for Conservation and Renewable Energy; Dr. Bob San Martin, the Deputy Assistant Secretary for Renewable Energy; Mr. Al Streb, the Deputy Assistant Secretary for Conservation.

If I may, Mr. Chairman, may I have the statement put into the record in full and——

Mr. FUQUA. Yes. Yes, without objection, if you wish to——

Mr. COLLINS. I appreciate it.

Mr. FUQUA [continuing]. Summarize, it would be perfectly permissible.

Mr. COLLINS. I very much appreciate the opportunity to appear here before this committee today to discuss the Department's views on the need for conservation and renewable energy facilities, and the Government role related to such facilities and the need, if necessary, of any legislative change—changes with regard to these facilities.

As you know, Mr. Chairman, after I assumed the position of Under Secretary this past August, one of the prime initiatives that—was the establishment of a thorough going review of proposed programs to ensure that adequate funding would be available and that adequate coverage was provided to a broad spectrum of technological options. Along this line, I reviewed every program with the Department and spoke with many people on Capitol Hill. And, as you know, our budget proposal this year was significantly different—the amount of money as it had—than it had been in the past. I think that we think at the same time it's very consistent with the fourth national energy policy plan that was announced by the Secretary and the President in October of last year.

The overall goal of that national energy policy plan was to foster an adequate supply of energy at reasonable costs. The strategies to achieve that were to minimize Federal control and involvement in the energy markets, but, at the same time, maintain public health, safety and environmental quality, and to promote a balanced and mixed energy resource system.

We think that the fiscal 1985 budget proposal from the President implements this strategy by supporting the development of a varied mix of technologies that contribute significantly to energy and introduce energy efficiency.

In allocating our resources, we concentrated on applying Federal funds where they are most effective—in sponsoring research and development and proof-of-concept efforts where the potential payoff is extremely high, for which private industry could not be expected to pursue, because the results were difficult to predict or return on investment would be exceptionally a long time to be realized. I think efforts will focus on improved dissemination of the results of R&D programs and on expanded collaboration of the private sector. Some certainly put that under the term of certainly technology transfer or high tech partnerships.

I think, within this context, the administration has directed the Federal energy R&D funding to emphasize basic and applied R&D and move away from the large-scale and costly demonstration and commercialization efforts. Now this change in emphasis reflects our confidence in the private sector's ability to make the best informed decisions about the production and use of energy, as well as our determination to recognize budget constraints and use Federal resources to their maximum advantage.

Therefore, it's recommended by the Energy—Energy Research Advisory Board that Federal energy research and development concentrates on the initial stages of technology development, basic research, applied research and proof-of-concept experiments.

I think it's important to address the transition from the Federal to the private sector responsibility. And, of course, that's what these hearings are centered on and where there is a lot of question. I think as the technology approaches the conclusion of the proof-of-concept stage, its technical promise and market potential should become sufficiently known so that the private sponsors are prepared to assume an initiative in further development and commercialization.

At the same time, I think it should be pointed out that proof-of-concept is neither a size-determined nor a cost-determined matter. The proof-of-concept is a broad category of research which is technology determined. Therefore, there is no simple formula for efficient—effectively applying a standardized approach to proof-of-concept efforts. I think each situation must be judged independently based on the project specific conditions. This—I think proof-of-concept efforts are geared toward producing the requisite knowledge to permit industry to decide whether the concept merits further development.

Because the Government will likely be neither the seller nor the sole customer for new technologies, it is not in the best position to make that market-driven decision and select one technology over another. Therefore, I think the Government must exercise caution in venturing too far into the realm of these large and costly demonstration projects.

However, involving industry like we proposed in this year's budget under the fellowship program where we'd have 60 people from the private sector involved in our national labs can make a considerable difference. I think if they are involved in—heavily—in the funding and management of Federal projects, as well as the Department's increased emphasis upon technology transfer, this will help to ensure that private sector information is incorporated into the Government decisionmaking process.

Additionally, I think both the administration and the Congress have taken significant actions to assist in this transition from Federal to private responsibility. For example, various tax incentives have been provided for R&D expenditures under recent tax legislation, and some of the industries that are affected say that that will be their primary course of action if they are passed by this Congress and signed into law. And I think actions have also been taken to promote private sector arrangements that allow firms to conduct joint development efforts that might be too expensive for an individual firm to undertake.

In the technology transfer area, I think that's the key aspect of our Department's efforts, to smooth the transition from Federal responsibility to private responsibility. As a matter of fact, that in our budget proposal this year has increased by 500 percent. The Department believes the success of Federal R&D programs in providing options for private investment and commercial development depends in large measure upon the effective transfer of the results of federally funded R&D. The reciprocal process for which industrial priorities are considered early in the Federal planning process, technology transfer is a vital link, I think, between the public and the private sectors in this process.

In conclusion, Mr. Chairman, the national energy policy plan hopes to lead us to a technical and economic environment that will ensure continued development of the energy resource potential of energy conservation and renewable energy. R&D tax incentives and recent antitrust initiatives will be very helpful. In addition, federally funded research and development programs, cost-sharing and related technology transfer activities specifically promote full development of conservation and renewable energy as a critical element in a balanced and diverse energy resource system.

We believe, therefore, that the transition from Federal to private responsibility is generally being addressed in a very responsible manner and does not require the addition of large, costly demonstration projects. However, the Department believes that sufficient legislative authority, as well, is already available to conduct these necessary activities and sustain the technical momentum established by the Federal research community and industry. We are very confident that our fiscal year 1985 budget proposals will increase understanding of the potential for virtually all the most promising energy conservation technologies and renewable energy options, and will substantially contribute to the base of technical information required for informed decisionmaking.

Mr. Chairman, let me say that we're very pleased to have the input that we have gotten from the Congress, particularly members of this committee and the staff. And we feel we're coming closer to the interests of the Members of Congress in our budget and our overall approach, and certainly in light of the entire Congress, the conservation community, and particularly this subcommittee.

I appreciate the opportunity to make this presentation today.

[The prepared statement of Mr. Collins follows:]

STATEMENT OF

WILLIAM PATRICK COLLINS

UNDER SECRETARY

U.S. DEPARTMENT OF ENERGY

BEFORE THE

COMMITTEE ON SCIENCE AND TECHNOLOGY

SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS

U.S. HOUSE OF REPRESENTATIVES

JUNE 13, 1984

Mr. Chairman and Members of the Subcommittee:

I appreciate this opportunity to appear before you today to discuss the Department's views on the need for conservation and renewable energy facilities at a scale above the "proof-of-concept" level, the government role related to such facilities, and the need for legislative changes with regard to such facilities. I shall address this topic within the context of the goals and strategies set forth in the Fourth National Energy Policy Plan (NEPP-IV), published in October 1983. This plan provides a sound policy framework for discussing the appropriate role for government in the development of energy conservation and renewable energy technologies.

NATIONAL ENERGY POLICIES AND STRATEGIES

The overall goal of our national energy policy is to foster an adequate supply of energy at reasonable costs. This policy recognizes that "adequate supply" requires flexibility in the energy system, with no undue reliance on any single source of supply. The goal of "reasonable costs" suggests economic efficiency within the energy system, so that energy consumers, individuals, commercial and industrial users alike, are not penalized by economic rigidities introduced into the system by ill-advised governmental regulation. The strategies for achieving this energy policy goal are:

- to minimize federal control and involvement in energy markets while maintaining public health and safety and environmental quality; and

- o to promote a balanced and mixed energy resource system.

The FY 1985 budget request for energy conservation and renewable energy research and development programs implements these strategies by supporting development of a mix of technologies that can contribute to both energy supply and improved end-use efficiency. In allocating our resources, we are concentrating on applying Federal funds only where they are most effective: in sponsoring research and development (R&D) and proof-of-concept efforts where the potential payoff is high, but which private industry cannot be expected to pursue because the results are difficult to predict or a return on investment would require an exceptionally long time to be realized.

Efforts will also focus on improved dissemination of the results of our R&D programs and on expanded collaboration with the private sector. Through these activities we intend to gain additional insights into industrial research priorities early in the federal planning process; and improve upon an already effective technical information program to better provide timely knowledge to interested parties in a form responsive to their specific needs.

FEDERAL ENERGY RESEARCH AND DEVELOPMENT

Within this context, federally sponsored R&D and proof-of-concept efforts serve two critical purposes. First, they advance the frontiers of our scientific and technical knowledge and provide the fundamental building blocks for technological innovation. Second, federal energy research and development programs support development of new and alternative energy resources, including conservation, by providing scientific and engineering knowledge for further development outside the federal sector. Federal research and development programs in areas such as renewable energy and energy conservation technologies are useful precursors to commercialization of the new fuels and technologies needed to foster a balanced and mixed energy resource system over the long term.

As discussed here, research and development activity can be described in terms of the path of technology development and the stages through which new technologies pass until they reach the market as competitive energy investment options. As recommended by the Energy Research Advisory Board (ERAB), federal energy research and development concentrates on the initial stages of technology development. Basic research involves the development of scientific knowledge, including a fundamental understanding of the physical and chemical properties of new or unconventional fuel sources or energy systems. Applied research includes the broad engineering and physical science aspects of specific energy technologies. Proof-of-concept establishes the technical viability and basic engineering feasibility of a concept and indicates its expected economic and environmental performance standards, permitting industry to make decisions concerning whether the concept merits further development.

FEDERAL ROLE IN ENERGY RESEARCH AND DEVELOPMENT

The DOE Conservation and Renewable Energy programs are part of a balanced energy research and development strategy that recognizes the need for the development of a full range of energy technologies which can compete in a free market environment. Within this context, the Administration has redirected federal energy research and development funding to emphasize basic and applied research and development and to move away from the large scale demonstration and commercialization efforts that accounted for a large portion of the Conservation and Renewable Energy research dollars in previous years. This change in emphasis reflects our confidence in the private sector's ability to make the best informed decisions about the production and use of specific fuels, technologies, and energy-efficiency improvements. It also reflects the Administration's determination to recognize budget constraints and to use federal resources to their maximum advantage by spreading limited federal funding across the broadest possible range of alternatives, providing the maximum number of technology options for industry support.

In choosing among the broad range of alternatives, the federal role in energy R&D is directed to areas where the incentives for and availability of private investment are severely limited or nonexistent. In particular, the government will support research activities that result in new knowledge from which commercial technology may ultimately be derived. In this regard, proof-of-concept efforts are geared toward producing the requisite knowledge to permit industry to decide whether the concept merits further development.

TRANSITION FROM FEDERAL TO PRIVATE SECTOR RESPONSIBILITY

As efforts move from basic research toward commercialization, the federal responsibility decreases as the private sector responsibility increases. "Proof-of-concept," therefore, represents the limits of the majority of the Federal government's direct funding involvement in energy conservation and renewable energy research and development. At this point, the technology base has been developed. As a technology approaches the conclusion of the proof-of-concept stage, its technical promise and market potential should become sufficiently known so that private sponsors are prepared to assume the initiative in further development and commercialization efforts.

Since there is such a broad range of renewable energy options and energy conservation technologies, at varying stages of development, with varying degrees of perceived as well as real technical and economic risks, the Department approaches this transition from federal to private responsibility on a case-by-case basis. In this regard, the utility of proof-of-concept experiments in the Department's Conservation and Renewable Energy R&D programs is enhanced by tailoring arrangements to each project. There is no simple formula for effectively applying a standardized approach-- each situation must be judged independently based upon project specific conditions. Thus, the federal government might support experimental prototypes to identify key gaps in knowledge or to test predictions. However, it is uniquely industry's role to translate this knowledge into commercial processes and products.

Because the government will likely be neither the seller nor the sole customer for new technologies, it is not in the best position to make the market-driven decisions necessary to select one technology over another. Since the private sector is in a better position to make such decisions, the Department recognizes that some research efforts may not be considered by the private sector to be of sufficient merit to warrant further investment. Therefore, government must exercise caution in venturing into the realm of large demonstration projects. Such activity is not only costly, but is also prone to failure. This tendency toward failure results not from the government's inability to make technical decisions, but from the fact that government is not well suited to make what are essentially market decisions. This problem is well documented in a recent article in SCIENCE ("Industrial Innovation Policy: Lessons from American History," 18 February 1983) and has been studied extensively elsewhere.

Therefore, the government must be wary of taking on a demonstration effort without fully understanding why the private sector is not supporting a particular technology. Involving industry in the funding and management of federal projects, as well as the Department's increased emphasis upon technology transfer, helps to ensure this understanding and to inculcate private sector information into the government decision-making process. Therefore, consistent with recommendations received from the Energy Research Advisory Board, the federal role does include the initial stages of technology development --basic research through proof-of-concept. However, the federal responsibility does not generally include support for multiple application demonstration models, or subsequent engineering development activities. There may be times when a particular technology would require development beyond the laboratory bench scale in order to complete proof-of-concept and prepare for final development and commercialization by the private sector. In order to ensure a responsible approach he transition from federal to private responsibility, the Department seeks private cost-sharing for proof-of-concept experiments, with the amount negotiated on a case-by-case (project-specific) basis.

Additionally, the Administration and the Congress have taken several significant actions that assist in this transition. For example, while the Administration has not generally requested funds for projects beyond the proof-of-concept stage, several financial alternatives are available to private sector firms other than direct federal financial participation. Various tax incentives have been provided for R&D expenditures under recent tax legislation. Action has also been taken to promote private sector arrangements that allow firms to conduct joint development efforts that might be too expensive for an individual firm to undertake. Because they maximize private sector involvement in the selection of specific technologies and in other private investment decisions, mechanisms such as tax incentives and joint venture financing should be the preferred choices for private firms seeking assistance for large pilot plants or integrated system level pilot facilities at near commercial scale, commonly referred to as "semiworks."

TECHNOLOGY TRANSFER

Another key aspect of the Department's efforts to smooth the transition from federal responsibility to private responsibility is our emphasis upon technology transfer. The Department believes that the success of federal research and development programs in providing options for private investment and commercial development depends in large measure upon effective technology transfer. This involves the prompt and effective transfer of results from federally funded generic research and development activities to private entrepeneurs, innovators, businesses, and industry and in facilitating transfers of technology within the private sector.

In the Conservation and Renewable Energy programs, technology transfer efforts provide a mechanism to transfer research results, experiences and "lessons learned" to many groups and individuals within the private sector research and manufacturing communities. A reciprocal process through which industrial priorities are considered early in the federal planning process, technology transfer is a vital link between the public and private sectors in the research and development process. Therefore, the Department's approach involves working closely with industry from the inception of an R&D project to ensure that the research results are transferred in an effective manner.

In cooperation with industry, various mechanisms for technology transfer are being assessed in order to determine the best methods for meeting private sector needs. Various information dissemination methods, seminars/workshops/conferences, a fellowship program to sponsor private researchers at the Department's national laboratories, cooperative research projects, cost-sharing, fee-paid user test facilities, and technology transfer centers are among the mechanisms that are being reviewed. Recognizing the critical importance of effective technology transfer to the success of national energy policy, the Department will intensify its emphasis on effective management of the process through which it is accomplished.

CONCLUSION

National energy policy seeks to foster a technical and economic environment that will ensure continued development of the energy resource potential of energy conservation and renewable energy. The President's Economic Recovery Program provides broad-based benefits toward this end. In addition, federally funded research and development programs and related technology transfer activities specifically promote full development of conservation and renewable energy as critical elements in a balanced and diverse energy resource system.

We believe that the transition from federal to private responsibility is being addressed in a responsible manner and does not require the addition of large demonstration projects. In order to assist in this transition, the Department seeks private sector cost-sharing for proof-of-concept experiments, with the amount negotiated on a case-by-case basis, and in conjunction with our technology transfer efforts. The Department believes that sufficient legislative authority is currently available to conduct the necessary activities and to sustain the technical momentum established by the federal research community and industry. We are confident that our Fiscal Year 1985 budget proposals will increase understanding of the potential for virtually all of the most promising energy conservation technologies and renewable energy options, and will substantially contribute to the base of technical information required for informed decision making.

Thank you for the opportunity to make this presentation today.

Mr. **Fuqua**. Thank you very much, Mr. Collins.

On page—well, I didn't think it was that far back—page 3 of your prepared statement, you talk about the proof of concept. We had other members, Mr. Boggs, Mr. Vaughan, up last week, and I'm sure you've been prepared as to what was discussed about proof of concept. You cite a definition, and I was just wondering if that means simply proving that technology works or that it doesn't work, or does it involve determining whether the technology can produce energy reliably at acceptable cost in a commercial system?

Mr. **Collins**. Well, I think, Mr. Chairman, that the definition that I saw from reports of last week's hearings, although I don't have the entire transcript of either, is that proof of concept is a broad definition, as I said in my confirmation hearings and after talking with many Members of Congress that were concerned about that. And it's certainly a continuum. I thought that the best thing that came out of the hearings was the definition as to find out if it works. And I think if it works, includes everything that you mentioned previously. We are trying to find out if it works and present that to the private sector.

Mr. **Fuqua**. So you would classify something like Solar I as a proof-of-concept project?

Mr. **Collins**. Well, I think in the Barstow situation, that we think at this stage, yes, that that fits within the definition.

Mr. **Fuqua**. I'm not talking about what they're talking about—

Mr. **Collins**. Proposal, yeah.

Mr. **Fuqua** [continuing]. In the future, but——

Mr. **Collins**. Yes, sir.

Mr. **Fuqua** [continuing]. The one we know as Solar I today at Barstow.

Mr. **Collins**. Yes, sir.

Mr. **Fuqua**. Now how about something like your SMUD project at Sacramento?

Mr. **Collins**. Well, I think, in the early parts of the SMUD project, it may be the proposals that have been up here for the ensuing 2 years. I think that we have probably completed that proof of concept, although that's been on the margin. I've talked to Congressman Fazio and others who are vitally interested in that project, and he indicates that, for example, there may be a training function in there that fits into that even basic and applied type of research.

I think that each of these really should be approached individually. We have about 500——

Mr. **Fuqua**. I understand that.

Mr. **Collins**. And—and, quite frankly, we're really pleased with the support we've gotten from Congress. Basically the budget process that has gone down this year of about 500 projects that I'm responsible for, the amount of difference between the Congress and us is down to about 3 projects out of 500.

Mr. **Fuqua**. Uh-huh.

Mr. **Collins**. So, we seem to have a great deal of agreement on that, and I think there's a flexibility in that, and I understand the Congressman's interest in a potential training function there. And, I think, up until now, it certainly has been in that—could be considered in that pool.

Mr. FUQUA. How would you classify something like the Heber geothermal project?

Mr. COLLINS. Well, I think that that's a proof of concept, the binary part of that. It's something new that we're looking into. I think that, at this stage—or the stage that we've gone to—that fits within that.

Mr. FUQUA. Well, I guess, if you're trying to get a proof of concept, and if that involves determining the cost and performance, which is very essential to whether technology is worthwhile or not, or could be cost effective—or at least you know the parameters of cost and then you apply the market conditions. Doesn't that, in most cases, require building a system to test the experiment in some kind——

Mr. COLLINS. Well, I think that——

Mr. FUQUA [continuing]. That you could get what is reasonably reliable cost and performance factors?

Mr. COLLINS. I think that—that certainly, and maybe a couple of the ones that we just mentioned, are examples of that, that where we have gone down that trail to some degree. And I'm not uncomfortable with that at all.

Mr. FUQUA. I think Solar I is a good example. Now they have been pleased with the performance of that project and are now exploring the idea of a much, much larger project, I think, in the neighborhood of 150 megawatts or something of that magnitude.

Mr. COLLINS. Yes.

Mr. FUQUA. That, to me, is what it's all about.

Mr. COLLINS. Uh-huh.

Mr. FUQUA. Maybe somebody else can pick up that technology and use it without Government help. But the Government finally went through the risk stage of it, and——

Mr. COLLINS. Absolutely. I think that's—that the 5-year program that we have for that project that we are halfway through now, that we're certainly in the proof of concept and we're looking—we're laying the groundwork for, hopefully, a takeoff by private industry on that.

Mr. FUQUA. Well, what do you think about Federal—or cost-sharing projects where there may be a little larger, the cost is greater, say, the Heber project or—Solar I was not an inexpensive project——

Mr. COLLINS. Yes.

Mr. FUQUA [continuing]. From the standpoint of capital outlay. But if we have Federal cost sharing on demonstration projects that are initiated by the private sector when they're willing to share some of the risk, but they can't feel comfortable in sharing all of the risk.

Mr. COLLINS. That's correct.

I'm extremely comfortable. I like the cost-sharing aspect to that, Mr. Chairman, because not only do you save some money for the Government, but you get the executives of those who are doing the cost sharing involved in it, and it makes it a better program from a management sense, and probably from a technical sense, as well. I think that can be extremely flexible and every project on that should be looked at on its merits. Some with the university community that were involved, it would be very miniscule, but with others, I think that they should play a significant role.

Mr. FUQUA. Well, we've had testimony from EPRI and GRI that said that, again repeatedly, the same story we've heard for year in, year out, that private industry cannot fund all the prototype or demonstration projects for advancing the technology, but they're willing to put up money, and sometimes a good portion of their money. EPRI, I think, said they had set aside something like $750 million for—over the next several years for use in those projects. And it seems to me it would be prudent for the Government to support such commitments that we get from industry.

Mr. COLLINS. Mr. Chairman, I think that's a—$750 million is extremely significant, as you suggest. I think that we're willing to look at every single project across the board, all 500-and-some that we're involved in, on that basis, on what part that they would like to play in this. I set up a system when I first came to the Department to look, in a budgetary sense, at every one of our projects like that, and I think that those will do better in the internal budget process within the administration if there is that participation.

Mr. FUQUA. Let me ask you one question, and you can supply the answer for the record.

Mr. COLLINS. Yes, sir.

Mr. FUQUA. When Mr. Vaughan was before us last week, I asked him for a summary of the state-of-the-art fossil technologies that was under development by DOE, and maybe you could provide that for each of the technologies that are under your jurisdiction. And——

Mr. COLLINS. Yes, sir.

Mr. FUQUA. We would appreciate getting our list up to date.

Mr. COLLINS. Yes, sir. I read that question.

Of course, we've been doing research at the Department in that fossil area for a lot longer, and it's a little bit more definite on those projects. And certainly, in many of our instances, we're making market. I think that we think we're sort of homesteading the frontier in many instances on this, and so it's not quite as definitive as that, but we'll be glad to.

[The information follows:]

The Department is providing the Subcommittee with two documents prepared for planning purposes by the Office of Conservation and the Office of Renewable Energy which provide the requested information on the state-of-the-art of each of the conservation and renewable energy technologies. It was felt that the additional detail of the conservation document was necessary to meet the Subcommittee's needs due to the variety and difficulty of aggregation presented by the many conservation technologies.

PHOTOVOLTAICS

TECHNOLOGY DESCRIPTION

- CONVERT SOLAR RADIATION DIRECTLY TO ELECTRICITY THROUGH PV CELLS THAT PRODUCE AN ELECTRON FLOW (ELECTRIC CURRENT) WHEN EXPOSED TO LIGHT

TECHNOLOGY STATUS

- COST OF PV AT $1.50 PER kWh TODAY
- CONVERSION EFFICIENCY OF LABORATORY CELLS IS 18% IN CRYSTALLINE SILICON AND 11% FOR THIN FILMS
- MODULE LIFE EXPECTANCY INCREASED TO TEN YEARS
- ESTABLISHED TECHNICAL FEASIBILITY OF RESIDENTIAL, INTERMEDIATE AND CENTRAL STATION PV SYSTEMS

PHOTOVOLTAICS (CONTINUED)

RESEARCH FOCUS

- MATERIALS RESEARCH TO IMPROVE EFFICIENCY, STABILITY AND COST OF PV CELLS
- COLLECTOR RESEARCH TO ESTABLISH THE TECHNOLOGY FOR MORE COST-COMPETITIVE PV CELLS AND MODULES
- SYSTEMS RESEARCH TO IMPROVE OVERALL PERFORMANCE AND REDUCE COSTS

KEY DEVELOPMENT EFFORTS

- COST-SHARED 2 MW PROJECT UNDERWAY AT SACRAMENTO MUNICIPAL UTILITY DISTRICT (SMUD) IN CALIFORNIA
- PROGRAM MONITORING PRIVATELY-FUNDED ARCO SOLAR 1 MEGAWATT POWER PLANT
- APPROXIMATELY $50 MILLION SPENT IN U.S. ON PRIVATE SECTOR R&D IN 1982
- WORLDWIDE PV SALES APPROXIMATELY 18 MW IN 1983 -- ANTICIPATE INCREASE TO APPROXIMATELY 40 MW BY 1985

SOLAR THERMAL

TECHNOLOGY DESCRIPTION

- CONVERTS RADIANT SOLAR ENERGY TO HEAT AND/OR ELECTRICITY AT ELEVATED TEMPERATURE THROUGH PROCESS OF CONCENTRATION AND ABSORPTION

TECHNOLOGY STATUS

- SUCCESSFULLY DEMONSTRATED CENTRAL RECEIVER TECHNOLOGY AT THE BARSTOW 10MWe PILOT PLANT
- SOLAR THERMAL ENERGY COST APPROACHING $8.00/M Btu (USING STATE AND FEDERAL INCENTIVES ON A LIFE-CYCLE COST BASIS)
- ACHIEVED THE HIGHEST NEW CONVERSION OF SUNLIGHT TO ELECTRICITY (26%) WITH PROTOTYPE PARABOLIC DISH/STIRLING ENGINE SYSTEM
- RECENTLY COMPLETED MASS PRODUCIBLE DESIGN STUDIES FOR TROUGH TECHNOLOGY

SOLAR THERMAL (CONTINUED)

RESEARCH FOCUS

- o HIGHER TEMPERATURE CAPABILITIES WHILE MAINTAINING MATERIALS AND COMPONENT PERFORMANCE
- o REDUCE CONCENTRATOR WEIGHTS TO REDUCE COSTS

KEY DEVELOPMENT EFFORTS

- o CONTINUED EVALUATION AND TESTING OF 10MW CENTRAL RECEIVER PILOT PLANT AT BARSTOW, CALIFORNIA
- o PROJECT EVALUATIONS OF MOLTEN SALT ELECTRIC EXPERIMENT AND SMALL COMMUNITY SYSTEMS EXPERIMENT
- o INDUSTRY CONSISTS OF ABOUT 50 COMPANIES, RANGING FROM SMALL HIGH TECHNOLOGY FIRMS TO LARGE AEROSPACE AND PETROLEUM COMPANIES

WIND ENERGY SYSTEMS

TECHNOLOGY DESCRIPTION

- CONVERT THE KINETIC ENERGY IN THE WIND INTO MORE USEFUL FORMS OF ENERGY E.G., ELECTRICITY OR MECHANICAL ENERGY

TECHNOLOGY STATUS

- COST OF ELECTRICITY FROM LARGE WIND MACHINES (>1MW) IN THE 6-10¢ kWh RANGE AND 10-15¢ kWh FOR SMALL MACHINES (<100kW)
- TREND MOVING TOWARD INTERMEDIATE-SIZE TURBINES (100-150kW) FOR FUTURE INSTALLATIONS
- TURBINE RELIABILITY (FOR SMALL AND INTERMEDIATE SIZE SYSTEMS) DRAMATICALLY INCREASED IN THE PAST 12 TO 18 MONTHS DUE TO WINDFARM OPERATING EXPERIENCE AND PRODUCT IMPROVEMENTS

WIND ENERGY SYSTEMS (CONTINUED)

RESEARCH FOCUS

- AERODYNAMICS - AIRFOILS, CONTROL STRATEGIES, ROTOR-STRUCTURE INTERACTIONS
- STRUCTURAL DYNAMICS - NATURAL FREQUENCIES, FATIGUE/FRACTURE, MATERIALS, COUPLED LOADS
- ATMOSPHERIC FLUID DYNAMICS - WIND TURBULENCE, WIND SHEAR

KEY DEVELOPMENT EFFORTS

- ROCKY FLATS SMALL WIND TEST CENTER MAINTAINED BY DOE. AVAILABLE TO INDUSTRY ON A FEE-PAID BASIS.
- COST-SHARED ENGINEERING AND COMPONENT DEVELOPMENT TESTING FOR INDUSTRY-FUNDED PROTOTYPE DEVELOPMENT OF MOD-5 MULTI-MEGAWATT WIND TURBINE
- 40-50 SMALL COMPANIES PRODUCING WIND MACHINES
- APPROXIMATELY 4000 TURBINES WITH TOTAL CAPACITY OF 120 MW CURRENTLY OPERATING IN THE U.S.

ACTIVE SOLAR HEATING & COOLING

TECHNOLOGY DESCRIPTION

- USES SOLAR COLLECTORS TO CAPTURE AND CONVERT SOLAR RADIATION TO THERMAL ENERGY FOR WATER HEATING OR SPACE CONDITIONING.

TECHNOLOGY STATUS

- EARLY ESTIMATES INDICATE THIN-FILM POLYMERIC COLLECTOR COULD BE FABRICATED & INSTALLED AT COST OF $8 PER SQUARE FOOT COMPARED WITH $15-$20 FOR CURRENT GENERATION FLAT-PLATE COLLECTORS OF COMPARABLE PERFORMANCE

- ACTIVE SOLAR WATER HEATING SYSTEMS STILL A FACTOR OF 2-3 AWAY FROM COST COMPETITIVENESS WITH CONVENTIONAL WATER HEATING SYSTEMS

RESEARCH FOCUS

- LOW COST POLYMERIC MATERIALS THAT WILL MAINTAIN PERFORMANCE CHARACTERISTICS OVER 10-20 YEAR SERVICE LIFE

- ADVANCED HIGH TEMPERATURE COLLECTORS

- ABSORPTION CHILLERS AND DESICCANT DEHUMIDIFIERS

ACTIVE SOLAR HEATING & COOLING (CONTINUED)

KEY DEVELOPMENT EFFORTS

- UNIVERSITY OF CHICAGO'S COMPOUND PARABOLIC CONCENTRATING (CPC) OR "WINSTON" COLLECTOR ACHIEVED THE BEST HIGH TEMPERATURE PERFORMANCE EVER MEASURED WITH A STATIONARY COLLECTOR
- CONTINUE SUPPORTIVE ROLE TO INDUSTRY BY OPERATING NATIONAL SOLAR DATA NETWORK
- APPROXIMATELY 600,000 ACTIVE SOLAR INSTALLATIONS
- 3 PERCENT OF U.S. HOMEBUILDERS OFFER SOLAR HOT WATER SYSTEMS AS STANDARD FEATURES
- APPROXIMATELY 270 COLLECTOR MANUFACTURERS
- LEADING COLLECTOR MANUFACTURING FIRMS PRODUCE $10-25 M IN HARDWARE PER YEAR

PASSIVE AND HYBRID SYSTEMS

TECHNOLOGY DESCRIPTION

- TO MINIMIZE CONVENTIONAL ENERGY CONSUMPTION, THE BUILDING IS USED TO MODULATE THE INTERACTION BETWEEN THE ENVIRONMENT AND THE BUILDING INTERIOR

TECHNOLOGY STATUS

- OVER 90,000 NEW HOMES INCORPORATE PASSIVE HEATING TECHNIQUES; 28,000 CONSTRUCTED IN 1982
- PASSIVE SOLAR HOMES PROVIDE 20% TO 75% OF HOME HEATING REQUIREMENTS
- DAYLIGHTNG IS THE MOST COST-EFFECTIVE PASSIVE STRATEGY FOR COMMERCIAL BUILDINGS

RESEARCH FOCUS

- DEVELOP AND EVALUATE PASSIVE TECHNIQUES FOR HEATING, COOLING AND LIGHTING FOR RESIDENTIAL AND COMMERCIAL BUILDINGS
- DEVELOP GLAZING MATERIALS WITH HIGH VISIBLE TRANSMITTANCE TO REDUCE HEAT LOSS BY A FACTOR OF 2 OR MORE OVER CURRENT GLAZINGS

PASSIVE AND HYBRID SYSTEMS (CONTINUED)

- IMPROVE TRANSPORT SYSTEMS TO DOUBLE HEAT TRANSFER EFFECTIVENESS OF THE BUILDING ENVELOPE
- DEVELOP STORAGE MATERIALS WITH IMPROVED HEAT CAPACITY AND CONDUCTANCE

KEY DEVELOPMENT EFFORTS

- CONTINUE LEADERSHIP POSITION IN ANALYSIS AND PREDICTION OF HEAT TRANSFER IN BUILDINGS
- PROVIDE BUILDING INDUSTRY AND DESIGN PROFESSIONALS WITH PERFORMANCE DATA

BIOMASS

TECHNOLOGY DESCRIPTION

- ENERGY SYSTEMS WHICH UTILIZE RESIDUES AND WASTE FROM AGRICULTURAL, FORESTRY, AND LIVESTOCK OPERATIONS; GRAINS AND SUGAR CROPS; AND WOODY, HERBACEOUS, AND AQUATIC CROPS
- CONVERTED THROUGH THERMOCHEMICAL, BIOCHEMICAL OR PHOTOBIOLOGICAL MEANS TO GASEOUS, LIQUID AND SOLID FORMS

TECHNOLOGY STATUS

- MICROALGAL: SPECIES IDENTIFIED HAVING 50% OIL CONTENT
- HERBACEOUS: SUGAR CANE YIELDS 36 DRY TONS/ACRE
  - IDENTIFIED 3 FAMILIES OF NATIVE SEMI-ARID PLANTS WITH HIGH EXTRACTABLE HYDROCARBON FRACTIONS
- SHORT-ROTATION WOODY CROPS: 6 DRY TONS/ACRE AT COST OF $4.5/MILLION BTU's
- MEDIUM BTU GASIFICATION: SUCCESSFUL CONVERSISON OF SOLID BIOMASS TO GAS WITH 30-50% HEATING VALUE OF NATURAL GAS

BIOMASS (CONTINUED)

RESEARCH FOCUS

- o MICROALGAL: DEFINE SPECIES WITH HIGH OIL CONTENT AND TOLERANCE FOR SALINE WATER
- o HERBACEOUS: TESTING SPECIES PERFORMANCE ON UNUSED AND MARGINAL LANDS
- o MEDIUM BTU GASIFICATION: TO OBTAIN COST OF $4-5/MILLION BTU'S
- o TECHNICAL IMPROVEMENTS IN THE PROCESSES FOR PRODUCING FUELS FROM BIOMASS THROUGH LIQUEFACTION AND PYROLYSIS

KEY DEVELOPMENT EFFORTS

- o SUCCESSFULLY COMPLETED EVALUATION OF WOODY BIOMASS PRODUCTION ON A COMMERCIAL SCALE AT EVANSTON, ILLINOIS
- o OPERATING THE ONLY SHALLOW, HIGH-EFFICIENCY EXPERIMENTAL ALGAL CULTURAL SYSTEM IN THE WORLD AT THE UNIVERSITY OF HAWAII
- o MORE THAN 48 MAJOR COMPANIES OFFERING COMMERCIAL EQUIPMENT FOR SALE
- o BIOMASS FUELS SUPPLYING APPROXIMATELY 1.5 TO 3.5% OF U.S. ENERGY CONSUMED
- o FEDERAL EFFORT STRIKES A BALANCE BETWEEN PRODUCTION OF FEEDSTOCKS AND THEIR CONVERSION TO FUELS

ENERGY FROM MUNICIPAL WASTE (EMW)

TECHNOLOGY DESCRIPTION

- EMW SYSTEMS UTILIZE THE ORGANIC OR COMBUSTIBLE PORTIONS OF SOLID WASTES AND CONVERT THESE MATERIALS TO VARIOUS ENERGY PRODUCTS (E.G., STEAM, ELECTRICITY)

TECHNOLOGY STATUS

- APPROXIMATELY 52 DEMONSTRATION AND COMMERCIAL SCALE PROJECTS EXIST
- 4 DIFFERENT TYPES OF EMW PROCESSES -- COMBUSTION, REFUSE-DERIVED FUEL, PYROLYSIS AND BIOLOGICAL -- AT VARYING STAGES OF DEVELOPMENT
- CAPACITY EXISTS TO PROCESS APPROXIMATELY 4% OF THE 150M TONS OF MUNICIPAL SOLID WASTES GENERATED EACH YEAR IN THE U.S.

RESEARCH FOCUS

- LIQUID OR GASEOUS FUELS PRODUCTION USING THERMOCHEMICAL OR BIOCHEMICAL PROCESSES
- UTILIZATION OF WASTEWATER PRODUCTS FOR ENERGY AND REDUCING ENERGY CONSUMPTION IN WASTEWATER TREATMENT
- MAJOR RESEARCH EFFORTS CONDUCTED AT ARGONNE NATIONAL LABORATORY

ENERGY FROM MUNICIPAL WASTE (EMW) (CONTINUED)

KEY DEVELOPMENT EFFORTS

- FOR THE PAST 3 YEARS, REFUSE CONVERSION TO METHANE (REFCOM) EXPERIMENTAL FACILITY, A COST-SHARED VENTURE, HAS PRODUCED METHANE WITHOUT MAJOR DIGESTER UPSET AND DECREASED ENERGY NEEDS FROM 500 TO 50 HORSEPOWER
- ANAEROBIC UPFLOW DIGESTER (ANFLOW) CONTINUES HIGH-STRENGTH EFFLUENT TREATMENTS
- ASSESSED PRESENT STATE OF THE TECHNOLOGY FOR INCLUSION IN INDUSTRY DATA BASE
- 40-50 COMPANIES DIRECTLY INVOLVED IN MUNICIPAL WASTE INDUSTRY
- MUNICIPALLY-OWNED NORTHWEST CHICAGO FACILITY BURNS 1200 TONS OF WASTE PER DAY TO PRODUCE STEAM THEN SOLD TO LOCAL COMPANIES

OCEAN ENERGY TECHNOLOGY

TECHNOLOGY DESCRIPTION

- OTEC UTILIZES THE TEMPERATURE DIFFERENCE BETWEEN THE WARM SURFACE WATER AND COLD BOTTOM WATER BY EMPLOYING A RANKINE HEAT CYCLE TO DRIVE A TURBINE/GENERATOR WHICH PRODUCES ELECTRICITY
- CAPABLE OF SUPPLYING BASELOAD POWER
- WAVE SYSTEMS UTILIZE SINUSOIDAL MOTION OF THE WATER TO MECHANICALLY DRIVE A TURBINE

TECHNOLOGY STATUS

- CURRENT COST ESTIMATES OF $8-9000/kW DEVELOPED THROUGH THE CONCEPTUAL DESIGN OF THE 40 MWe PILOT PLANT PROOF-OF-CONCEPT EXPERIMENT
- SEACOAST TEST FACILITY IN HAWAII WILL SERVE AS TEST BED FOR BOTH OTEC CONCEPTS
- SMALL, EXPERIMENTAL PNEUMATIC WAVE ENERGY CONVERSION SYSTEM HAS BEEN CONSTRUCTED; TESTING HAS NOT BEGUN

OCEAN ENERGY TECHNOLOGY (CONTINUED)

RESEARCH FOCUS

- COLD WATER PIPE DEPLOYMENT AND INSTALLATION; ANALYZING DATA FROM STRESS TESTING OF SUSPENDED PIPE AND ANCHOR TESTING OF SLOPE-MOUNTED PIPE
- TO INCREASE HEAT TRANSFER EFFICIENCIES, WATER SIDE ENHANCEMENT OF HEAT EXCHANGERS FOR CLOSED-CYCLE OTEC BEING TESTED THROUGH INNOVATIVE DESIGNS AND NEW MATERIALS
- ANALYTICAL MODELS TO INCREASE OPEN-CYCLE OTEC PERFORMANCE
- ARGONNE NATIONAL LABORATORY EFFORT FOCUSED ON IN-SITU ANALYSIS OF BIOFOULING, CORROSION AND HEAT EXCHANGERS MATERIAL LIFE-CYCLE AT THE SEACOAST TEST FACILITY

KEY DEVELOPMENT EFFORTS

- CONSORTIUM OF 2 PRIVATE COMPANIES AND THE STATE OF HAWAII COST-SHARING PHASE II, THE PRELIMINARY DESIGN OF 40 MWe PILOT PLANT, WITH DOE
- COST-SHARED 40 MWe CONCEPTUAL DESIGN COMPLETED

GEOTHERMAL ENERGY

TECHNOLOGY DESCRIPTION

o HYDROTHERMAL: HEAT OF STEAM/WATER CONVERTED TO ELECTRICITY OR DIRECT USE FOR SPACE OR INDUSTRIAL PROCESS HEATING

o GEOPRESSURED: SOURCE OF CHEMICAL (METHANE), THERMAL, AND MECHANICAL ENERGY

o HOT DRY ROCK: EXTRACTION OF ENERGY FROM MAN-MADE FRACTURES, CIRCULATED FLUID RECOVERED AS STEAM

o MAGMA: SCIENTIFICALLY FEASIBLE/EXTRACTION OF ENERGY

TECHNOLOGY STATUS

o HYDROTHERMAL

- HOT WATER/STEAM POWER PLANTS COST-COMPETITIVE
- 200 DIRECT USE APPLICATIONS IN U.S. UTILIZING 2.5 TRILLION Btu's/YEAR
- CURRENT WORLDWIDE TOTAL, 3,175 MWe

GEOTHERMAL ENERGY (CONTINUED)

- GEOPRESSURED
  - TECHNOLOGY AVAILABLE FOR PRODUCTION
- HOT DRY ROCK
  - ENERGY EXTRACTION CONCEPT PROVEN
- MAGMA
  - EXISTING GEOPHYSICAL TECHNIQUES ADEQUATE

RESEARCH FOCUS

- BINARY CYCLE TECHNOLOGY
- BRINE INJECTION METHODS; PRODUCTION FLUID LOSS CONTROL
- RESERVOIR MODELING
- GEOSCIENCE TECHNIQUES

GEOTHERMAL ENERGY (CONTINUED)

KEY DEVELOPMENT EFFORTS

- 1,237 MWe ON-LINE AT THE GEYSERS, CALIFORNIA
- COST-SHARED 50 MWe BINARY PLANT UNDER CONSTRUCTION IN HEBER, CALIFORNIA

HYDROPOWER

TECHNOLOGY DESCRIPTION

- CONVERTS THE KINETIC ENERGY IN FLOWING WATER INTO ELECTRICITY

TECHNOLOGY STATUS

- CURRENT COST OF ELECTRICITY FROM NEW LARGE HYDRO PLANTS (>30 MW) 6.1¢/kWh; FROM NEW SMALL PLANT (<30MW) 6.5¢/kWh
- ACCOUNTS FOR 4% OF TOTAL U.S. ENERGY CONSUMPTION (13% OF U.S. ELECTRIC GENERATION)
- APPROXIMATELY 150 LARGE PLANTS AND 1200 SMALL PLANTS ON-LINE, TOTAL CAPACITY ABOUT 65 GW IN U.S.

RESEARCH FOCUS

- COST REDUCTIONS THROUGH STANDARDIZATION OF SMALL PLANT EQUIPMENT
- USING STANDARD OFF-THE-SHELF PUMPS, OPERATING IN REVERSE, AS TURBINES
- CONTINUING ENVIRONMENTAL RESEARCH

HYDROPOWER (CONTINUED)

KEY DEVELOPMENT EFFORTS

- MOST ACTIVITY IS IN SMALL PLANT REHABILITATION
- 891 APPLICATIONS FOR PERMITS FILED WITH FERC IN 1982

Mr. **Fuqua**. Earlier in the year, the Biomass Energy Research Association testified before us that they needed government-industry cost-sharing of pilot plants to demonstrate the economics. There were a number of medium BTU gasification processes, and they included Battelle, Columbus, and SERI and International Harvester and some others.

Do you agree with government-industry cost-sharing pilot plants that are needed to help the private sector commercialize these technologies?

Mr. **Collins**. Well, I've just been to Battelle and have seen some of their work, read the proposals in the hearings and what has transpired on the budget process this year, and I think that, in the area of biomass, it's one of the real sleepers in the country, and it was just—some of the work was featured very prominently at the convention in Anaheim last week. I'm very big on that.

I think that sometimes when we get into these definitions of pilot plants and others on this continuum, I've got about three or four definitions I've seen for each one. And I do think that we want to be involved, and are involved in the research sense, very much in the biomass area, and are willing to look at any combination to help at—maximizing our efforts along that—certainly through the what we call the proof-of-concept, and some of the proposals they brought up to me have been like that.

I'd like to say also, Mr. Chairman, I've been surprised at the amount of industries who have not brought up proposals like this to me, and I'm most anxious to talk with more of them about the potential for cost sharing. I learned a lot from some of the hearings, some of—what's going on in your hearings.

Mr. **Fuqua**. In page 6 of your testimony, you stated that, in order to ensure a responsible approach to the transition from Federal to private sector responsibility, the Department seeks private sector cost sharing for proof-of-concept experiments. And that was the end of your statement. What are some of the examples of cost shared, proof-of-concept projects which have been initiated under the present administration?

Mr. **Collins**. Well, I'd like to say, Mr. Chairman, that every single one in our industrial; for example, every single program in industrial conservation is cost shared generally from 5 to 60 percent and that——

Mr. **Fuqua**. Yes; when was it initiated in the last 3 years?

Mr. **Collins**. I have a list that I would be glad to submit for the record, if I could.

Mr. **Fuqua**. Could you——

Mr. **Collins**. Certainly Mr. Streb could, who was head of industrial conservation before he became our Deputy Assistant Secretary.

Mr. **Fuqua**. Not the ones that were initiated by Congress, but the ones initiated by the Department in the last——

Mr. **Collins**. Be glad to submit that——

Mr. **Fuqua**. [continuing]. Three years.

Mr. **Collins** [continuing]. For the record, Mr. Chairman.

[The information follows:]

The Department is providing to the Subcommittee separate lists of renewable energy and energy conservation cost-shared, proof-of-concept projects which have been initiated under the present administration.

DEPARTMENT OF ENERGY PROPOSED
RENEWABLE ENERGY COST-SHARED PROOF-OF-CONCEPT
PROJECTS 1981-1984

Programs	Projects	Partners	Years funding requested
o Photovoltaics	o Dendritic Web Silicon Growth Process Development	Westinghouse Electric, Electric Power Research Institute, Southern California Edison, Pacific Gas & Electric	FY 1984, FY 1985
o Solar Thermal	o Barstow 10 MWe Pilot Plant Operations/ Testing	Southern California Edison, Los Angeles Water & Power, California Energy Commission	FY 1983, FY 1984, FY 1985
	o Molten Salt Electric Experiment	Electric Power Research Institute, Babcock & Wilcox, Black & Veatch, Martin Marietta, McDonnell Douglas, Olin, Arizona Pulbic Service, Pacific Gas & Electric, Southern California Edison	FY 1985
	o Innovative Concentrators	TBD	FY 1984, FY 1985
	o Parabolic Dish Stirling Engine System Module	Advanco Corp, United Stirling, Onan, Winsmith, Electrospace, Southern California Edison	FY 1985
o Biofuels	o Wood-Fueled Gas Turbine	Aerospace Engineering Corp.	FY 1982 , FY 1983
o Wind	o MOD-5 Multi-megawatt Turbine Development	Boeing, Hawaiian Electric CO., Electric Power Research Institute	FY 1985

DEPARTMENT OF ENERGY PROPOSED
RENEWABLE ENERGY COST-SHARED PROOF-OF-CONCEPT
PROJECTS 1981-1984

Programs	Projects	Partners	Years funding requested
o Wind (continued)	o Small Wind Testing Facility	Various manufacturers	FY 1984, FY 1985
o Ocean	o Seacoast Test Facility modification for seawater tests	State of Hawaii	FY 1985
o Geothermal	o Geopressured Resources- Electric Experiment	Electric Power Research Institute	FY 1985
	o Industry Cost-Shared Drilling Systems	TBD	FY 1985
	o Cascades Resource Characterization	TBD	FY 1985

OFFICE OF CONSERVATION

COST-SHARED PROOF-OF-CONCEPT PROJECTS

1981-1984

Program	Project	Partner(s)	Contract Period
Transportation	Advanced Dual-Shaft Electric Propulsion System	Eaton Corporation	June 1984-May 1988
Buildings	Rangerwood Villas-Vented Envelope Study	J.R. Hunt Enterprises	March 1983-March 1985
Buildings	Monitoring of local house	Small Homes Council, University of Illinois, Mr. McCully (house owner)	June 1982-June 1984
Industry	Fluidized Bed Waste Heat Recuperator	Aerojet	October 1982-July 1984
Industry	Fluidized Bed Waste Heat Recuperator	Thermo-Electron	July 1981-December 1984
Industry	Ceramic Recuperator	Babcock & Wilcox	August 1981-April 1985
Industry	Ceramic/Metal Tube Recuperator	Garrett	September 1981-June 1985
Industry	BiPhase Concentrator Cogeneration System	BiPhase Systems	September 1982-December 1985
Industry	Forest Residue Fuel Development	Gorham	September 1981-September 1984
Industry	Non-contact Measurement of Thermal State of Solids	Pacific Northwest Laboratories	July 1983-July 1986
Industry	Rapid In-process Analysis of Liquid Steel	Los Alamos National Laboratories	July 1983-January 1986

Industry	Thin Strip Casting Pilot Demonstration	U.S. Steel/Bethlehem	September 1984-unknown
Industry	Hierarchical Control	St. Regis Paper Company	July 1981-December 1989
Electric Energy Systems	Zinc-Bromine Battery Research	Exxon	1982-1986
Electric Energy Systems	Aluminum-Air Battery Research	Eltech	1984-1987

Mr. **Fuqua**. Also, there's been several industrial firms that have expressed an interest in attempting to commercialize solar-thermal, a central receiver system using molten salt and the heat's transferred in storage medium. And you're currently conducting a 750 kilowatt molten salt electric experiment at—out at Barstow, I understand. Do you think these two tests have a proof-of-concept definition or fall within that definition?

Mr. **Collins**. Yes, I think it certainly does, Mr. Chairman. In fact, some of our work in that area is almost R&D because we're not satisfied we've reached the optimum results from that work.

I might add it is strongly cost shared, which most of our successful programs are, in our experience, by the way.

Mr. **Fuqua**. I don't have any more questions. I just want to say that we have concluded these hearings with the Department's witnesses, and I'm still troubled, even though you have been more reassuring than many other people this morning about let George do it, and in this case George being the industry. It seems to me that our objective as a government is to assure the development and advance and transfer of technologies so that we can reduce the dependence on imported oil, and particularly on fossil fuels that we depend on. And we've learned over a large number of years from industry that Government assistance is required to commercialize advanced technologies. And we've heard a willingness on their part to cooperate, to work together, to share costs, and we've still run into roadblocks at the administration.

And one of the things that—it seems like that we've been—we need some kind of delivery system to do this, a systematic system, and the Department is the only place that we can do that. If we deal with Congress initiating all these, we get into a lot of ad hoc things, probably sometimes maybe not the best technology or the best programs. But I think it reflects a strong feeling on the part of Congress that we need to be doing something, and I think in—and it's not a partisan issue either. I think you find that Congress has been supportive on both sides of the aisle.

So it would be very helpful if we could have some systematic method that could market these programs and delivery systems out there. This ad hoc basis is not the best way to do it, and I would hope that we can take the delivery system that we have, which is DOE, and your part of DOE and some of the others, that we can make that work better.

I've been—I might say I've been very pleased to see the expansion of proof-of-concept, because I realize it can be very narrowly defined or broadly defined, and I'm not trying to expand it way out to large-scale commercial operations. But I do think we're not following through on an investment that the taxpayers have made, the time and effort of Government and non-Government individuals if we test an ounce of coal or if we test one little solar panel and not take it to a larger scale wherein we decide if it's a white elephant or not. And it may be a white elephant. We need to determine that so we can put it out of the way. But those that turn out to be viable, we certainly need to pursue with them.

I appreciate you being here this morning, and your associates, and you've been very cooperative, and we appreciate that very much.

Mr. Collins. Thank you very much, Mr. Chairman. I look forward to working with you on your goals.

Mr. Fuqua. Thank you very much.

Mr. Collins. Thank you, sir.

Mr. Fuqua. Our next witnesses will be Dr. Maxine Savitz and Dr. Ian Straughan.

Dr. Savitz, we're pleased to have you back again in a different capacity than you have generally appeared before this committee. We're very pleased to have you back.

STATEMENTS OF DR. MAXINE SAVITZ, WASHINGTON, DC; AND DR. IAN STRAUGHAN, DIRECTOR OF RESEARCH, SOUTHERN CALIFORNIA EDISON, ROSEMEAD, CA.

Dr. Savitz. Congressman Fuqua, I am very pleased to be here, and I want to say in appreciation of support that this committee has given to conservation for the past 10 years since when ERDA was formed both by the Democrats and the Republicans and the members and its staff. And I think one of the things that is shown by its support has been its consistency in supporting the technology developments of energy efficiency, which is one of the main things needed for successful development of technology.

What I'd like to do, if I could, is submit my entire statement for the record, and just summarize some of the points.

Mr. Fuqua. Yes, without objection, we'll make it part of the record.

Dr. Savitz. Although a decade has gone by since the embargo and we are using energy much differently than any of us ever predicted 10 years ago, there's still events occurring in the Middle East that remind us of our vulnerability, there are studies that are continually done to show us how much more energy we can save and—and use efficiently at very cost-effective prices. And many of the same reasons that conservation had a Federal role evolve over the seventies are still pertinent today, objectives to accelerate the development of long run economic efficiency in both the supply and use of energy, giving efficient pricing policies and information to overcome consumers' delayed response, to reduce uncertainties as we make transitions to renewable resource, reduce the Nation's vulnerability to oil supply disruption, and also to maintain our international competitiveness which, I think, is an issue that has arisen in the last few years that didn't exist 10 years ago. And it isn't just pertinent to conservation, but to all U.S. technologies that require an important role.

Well, over the past 10 years, there have been conservation programs that have had proof-of-concepts or demonstrations that have been successful. And one of the things that one learns is that it generally means that proving the technology is technically and economically viable so that the end-user will purchase it, install it, and use it. The technology itself can be proven from a technical point of view in the form of a proof-of-concept test of single full-scale operation over a period of time or by multiple demonstrations. The economic proof isn't shown until there's widespread adoption by the market.

The need and type of demonstration varies depending upon the end-use sector, the technology involved, the industry and the risk. And there are technologies, but there are also institutional barriers which demonstrations are required in order to gain market acceptance.

If a technology isn't technically ready, there should not be a demonstration, but resources should be spent developing the technology and testing it in specific application or a few advanced units. When technology is ready and the situation is appropriate, multiple-unit demonstrations can be funded to improve the economics, develop market infrastructures if necessary, and complete the technology transfer.

I think something like the heat engine program has shown where it's been focused—technology's been focused on a single application on an advanced ceramic engine, and the technology development of ceramics has been important to develop along with just the idea of a better and newer automobile engine, to have that interplay.

Before future cons—when conservation projects go on to demonstration or full proof of concept, you need to look at what the characteristics of a successful demonstration. Is a successful demonstration one where the technology or process has entered the market and been replicated? Is it one that in itself has saved energy, but has not necessarily been replicated? Is it one where parts of it have been replicated? Is it one where the technology has shown to be ready, is not economic at current prices, but is available quickly if needed during an unplanned emergency?

I think the answer is "yes" to all of those, and you have different types of demonstrations under those, and there have been various examples that the Department of Energy has funded in the past, that I've presented in my testimony.

I think when one looks ahead, one has to do—see what are the next 10 years going to look like and how are we—what kind of industry do we want in this country. Do we—are we going to continue to make our own steel, our own aluminum, our own textiles? Are we going to import it? I think if we are going to make it, we have to look at the energy efficient opportunities to those technologies.

Transportation, if we're moving toward having trucks consume more energy than automobiles, we need to focus on making those more efficient. It's not as easy to do as automobiles, in the sense you can't just down-size. And what are going to be the growing needs in our buildings? And from these, you can then determine what technologies should be given priority.

I think some of the demonstrations that have been done have shown the types of demonstrations you can do. In the industrial program where there was a—most of, many of these that have—did one proof of concept have been picked up in many units. One was coil coating from re-use of fumes. We paid—the Department of Energy, at the time, paid for one demonstration or proof-of-concept, and 30 units have been installed to penetrate—without any Federal support. So that has led to it.

Though you can finish a project such as trying to do the hot inspection of steel using some space-age technology, we did it on one slab, talked to the industry about picking it up, and they said they needed to do it on both sides and the whole piece, it wasn't ready for them. So that would require more—more demonstration.

In the buildings area, it's been interesting that several small companies have been funded to develop new technologies such as heat-pump water heaters and solid-state ballast, and have worked with the utilities in order to do some demonstrating of these in limited numbers to show that they—they work. And then now larger manufacturers make them. A dozen manufacturers are making heat-pump water heaters or solid-state ballast. But they had to be shown the data that they worked before they would—would go on it, and that was a successful demonstration.

But the buildings area is also unique in that it's not just technologies that have to be shown, but how do you get these hundreds of millions of homeowners, occupants of buildings, landlords, construction workers to build more efficient buildings or to manage them properly? So, you need to look at the various institutional barriers and try to do some delivery mechanisms, particularly for multifamily and small commercial buildings. We know very little, and very little has been done in those areas relative to what's been done in the single-family and to new construction, so that it's a different type of thing.

And then, as I said, the transportation program, the heat engine program, has shown where you can take whole new concepts to get a gas turbine engine made out of ceramics, develop the ceramic technology to a point where we might not see whole ceramic engines for years to come, but we're going to start seeing ceramic components, turbochargers in automobiles made both here and Japan in the next 2 years. All of that was done based on Federal technology development, though the actual turbocharger development was done by private sector.

The electric vehicle program, I think, is an example where the program was said to demonstrate, buy and subsidize 7,500 vehicles that—over a period of time. It was subsequently modified. But there was a program where there was too much emphasis on multiple units before the technology was ready. So, emphasis needs and has been placed on more advanced batteries, electric drive systems and to test a few units. So, I think that we've learned a lot from all of these in the past, and there's opportunity in—in the future.

I think one always wonders what about cost-sharing. I think cost-sharing is very important, but it should not be a fixed formula. Each sector in industry has its specific needs and constraints and, as it moves from one development phase to the next where the risk becomes reduced, the share of private sector cost-sharing should be—should be increased.

I think one can also use innovative payback or buyback schemes. This happened in the coil coating where government spent $400,000 and, based on the savings, the firm bought it back—actually purchased the units, so $200,000 were invested. Or you can have various kinds of royalty payments based on sales, with the Federal share being reimbursed.

I think the consistency of funding is very important for both—for industry to come to the table and cost share and needs a long-term commitment. And this committee has kept that long-term commitment going, but sometimes it's—it's been at odds with the administration. One wonders should there be multiple-year type of budgets or appropriations to keep—so that industry will come to the table, can make its decision, and will participate—also would reduce the necessity for overruns, for stretchouts and for inefficiency occurring. There's various mechanisms one can use. One can set up separate entities just for proof-of-concept or technology development so to have the fundings sort of set-aside, with good oversight throughout that so, if something doesn't work, you stop it and you don't keep funding it just because it started its multiple year, that type of thing.

There are other techniques that can be used, should there be some sort of R&D limited partnerships but where the Government puts in some share of money, not just all conversation with private sector. Should there be insurance programs where, if there is an industrial process that fails, the Government will pay for the down time while that new technology is being used? Or that might be a disincentive.

Should you modify something like the ManTech Program of DOD? The Canadians have done this whereby the Government helps to pay some of the share for the R&D related to manufacturing process and then there's a payback.

I think what needs to be done is to look at what are the various mechanisms and to do some serious analysis and see, you know, is it the way it's been going in the past with annual appropriations and each project at a time, or should there be some innovative ways, and look at both with what's done here and also what's being done in Europe and Japan.

In conclusion, I think demonstrations are particularly useful when there are a large number of decisionmakers that your trying to reach when the technology is unknown to them. When they perceive that the new technology might have high risk, perception is also—often as important as reality when the new technology is there so it can be seen, can be felt, can be kicked, can be seen in a real environment and not just in a makeshift laboratory environment, when the performance can be measurable so they can really see how its going to perform over time, and where it might be extremely slow introduction if there were no demonstration because—because of the—the factors.

I think we found we live in a world of intense international competitiveness and need to ensure the conversion to an efficient energy and efficient economy, have secure and alternative energy at affordable prices, and have these technologies available. So I believe that there must be a continual Federal-private partnership in moving end use technologies out of the laboratory and into the full-scale demonstrations.

I thank you very much and would be happy to answer any questions.

[The prepared statement of Dr. Savitz follows:]

STATEMENT OF

MAXINE SAVITZ

BEFORE SUBCOMMITTEE ON

ENERGY DEVELOPMENT AND APPLICATION

OF

COMMITTEE ON SCIENCE AND TECHNOLOGY

June 13, 1984

COST-SHARED ENERGY TECHNOLOGY DEVELOPMENT AND DEMONSTRATION PROJECTS

I am pleased to be here to discuss the need for conservation related facilities at a scale above so-called "proof-of-concept" but at less then commercial size, or for prototype demonstration projects and the government role related to such facilities. Although more than a decade has gone by since the embargo of 1973, the current events in the Gulf area remind us of our vulnerability and the need for a continued Government role in Conservation.

From 1972 to 1983 I was involved with the development and administration of Federal Conservation programs including the development of several demonstration programs. The implementation of these programs provides sound experience on which to develop future policy options. Today, I will focus on the national energy situation, the experience of the conservation program, and outline suggested conservation programs that are appropriate for continued Federal support.

The National Energy Situation - Consumption and Future Potential

As a nation we have dramatically altered our use of energy. In 1983, total energy consumption was 70.5 quads per year, 5 percent less than that used in 1973 but 28 quads less than many predicted for a business-as-usual-economy. Conservation has made and continues to make significant contribution to conserving energy and improving economic efficiency.

Improvements in energy efficiency are estimated to account for about 14 quads of reduced growth in energy demand and about 60 quads of cumulative energy savings over the last 10 years. Most of this decrease has taken place in the private sector. Probably the most influential factors in this shift have been energy prices and the threat of future shortages. Estimates by Oak Ridge National Laboratory and DOE suggest that government conservation programs resulted in as much as 20 percent to as little as 5 percent of the savings. Thus, the savings to the U.S. economy total as a minimum $3.5 billion, to as much as $14.0 billion in 1983 or up to 5 times as much as the government spent on energy conservation programs in the past 10 years.

In the individual sectors, accomplishments have been impressive. Automobiles made by the big three domestic manufacturers averaged 12 mpg in 1973; today the figure is closer to 24 mpg. Two of the three major U.S. makers, however, were below the government's 1983 target of 26 mpg. Thermal performance of new buildings has improved during the past decade. Recent survey data collected by DOE indicates average consumption of energy per household was approximately 114 MBtu per year with homes built after 1979 averaging only about 78 MBtus per year computed using site electricity. The industrial sector has also been responsive to energy prices. Energy efficiency per unit of production in the manufacturing industry improved by approximately 22 percent since 1972.

While the results are impressive and savings have occurred, there is still a tremendous potential for energy conservation in all sectors of the economy. It is estimated that between 20-40 percent additional savings can be achieved at less than $20 a barrel - a very cost effective alternative to imports at $29 a barrel. This is especially true when one realizes that many of the changes taking place to date were as a result of operational change.

There is no question that the nation will be under continued pressure in the future to adapt to evolving energy conditions. Events in the Middle East remind us that future supplies can be cut off. The current availability is due to a combination of factors including the recent economic recession. There have been no major oil or gas finds in this country for the past three (3) years. The U.S. continues to draw on non-renewable fuels (petroluem, gas, and coal) for 90 percent of its needs, not much below the 94 percent in 1973. Domestic production has slipped to 8.6 MBPD in 1983 compared with 9.2 MBPD in 1973. Thirty percent more coal is being mined, but production of domestic natural gas has declined by 26 percent between 1973 and 1983. After six years the strategic Petroleum Reserve of 750 million barrels is only 50 percent filled.

Thus, the Federal role for conservation that evolved in the 1970's is still pertinent today. The objectives are to (1) accelerate the development of long-run economic efficiency in both the supply and use of energy which requires efficient pricing policies and information to overcome consumers' delayed response to price;(2) reduce key uncertainties about the nation's energy future by creating new energy options and ensuing a smooth and equitable transition to domestically abundant fuels and renewable domestic energy sources; (3) reduce the nation's vulnerability to oil supply disruption; and (4) improve the U.S. competitive position in the world economy. The Federal role is to complement the marketplace and intervene where the market does not function or where there is market failure. Objectives 1 through 3 were pertinent 10 years ago and still are today. The fourth objective has become important more recently as we have seen imports increase in all the sectors of the economy. For example, 10 years ago less than 10 percent of the automobile were imported; today, 27 percent of the automobiles are imported and many U.S. automobiles have imported parts. This fourth objective is not unique for energy-efficient technologies.

Federal research, development, and demonstration programs for energy-efficient technologies in buildings, industry, and transportation were initiated in 1975 with the formation of the Energy Research and Development Administration (ERDA) and a FY 1975 budget of $12.8 million. Prior to that time, there was less than $10 million total spent on conservation programs, mainly at the National Science Foundation, the National Bureau of Standards, and the Federal Energy Administration. The thrusts of end-use programs developed at ERDA have formed the basis for the past 9 years of efforts and are still viewed as appropriate ones for Federal funding when reviewed by industry. Accomplishments have been reported in various budget submissions, the Sunset Review, Government reports; and evidenced by products, and processes introduced into the market. These government programs - particularly those in which industry has participated - have led to rapid transfer of the resultant technology into the private sector. Programs have covered research, development, and demonstration activities with Federal participation at different stages and levels depending upon the technology and its state of development.

From the experience of these conservation programs, several lessons have been learned about conducting demonstrations. The term demonstration or full-scale "proof-of-concept" projects, which is the focus of this hearing, has several interpretations. It generally means proving that a technology is technically and economically viable so that the end-user will purchase it, install it, and use it. The technology itself can be proven from a technical point of view in the form of a proof-of-concept test, a single full-scale operation over a period of time or by multiple demonstrations. The economic proof is not shown until there is widespread adoption by the market. The need and type of demonstration varies depending upon the particular end use sector, technology, industry, cost, risk, etc. There are technologies and institutional barriers for which demonstrations are required to gain market acceptance. If a technology is not technically ready, there should not be a demonstration of multi-units. Resources should be spent developing the technology and testing it in a specific application or in a few advanced units. When the technology is ready and if the situation is appropriate, multi-unit demonstations can be funded to improve the economics, develop market infrastructures if necessary, and complete technology transfer so that the implementation can continue unsubsidized in the market. In doing a demonstration of a radically new process or product such as ceramic gas turbines, it is important that a technology base be developed at the same time as the technology. In this arrangement, a new product is being developed for a specific application and there is a continuous feed-back between the application and technology development.

Future conservation demonstration projects should be based on a clear understanding of the characteristics of a successful demonstration. Is it one where the technology or process has entered the market and has been replicated? Is it one that has in itself saved energy but has not been replicated? Is it one where parts of it have been replicated? Is it one where the technology has been shown to be ready, is not economic at current prices, but is available quickly if need be during an unplanned shortage? There have been several successful demonstrations of technologies supported by ERDA and the Department of Energy that embody the characteristics noted above. Examples of these in each of the end use sectors - industry, buildings, and transportation - follow. It should be noted that many of these demonstrations included both the development of a technology per se as well as demonstrations of innovative practices and procedures to overcome market failures and institutional barriers to implement energy conservation. These examples are not meant to be comprehensive, but only illustrative. Also discussed are opportunities for the next decade of activities to ensure the continual progession to a more energy-efficient economy. These are preliminary ideas and in many cases include projects that extend or expand current programs. Prior to a more complete identification of projects there is a need for a comprehensive look at energy and technology trends over the next ten years, and for a determination of where the opportunities are for energy efficiency improvement and what differences will emerge from the past ten years of energy research. What industries are growing? What transportation modes are increasing? For what functions will energy be needed in buildings? Can RD&D programs be adjusted accordingly?

Industry

Since its organization in 1975, the industrial conservation program (IP) has demonstrated some of the most successful projects from a technological and implementation viewpoint. It has continued to track the implementation of technologies and processes which it has funded and has over the years initiated studies to analyze factors influencing the success of the projects. It has also utilized innovative contracting procedures to recover the costs of demonstration. Over 23 projects have been completed by the DOE industrial program (several initiated at ERDA) and are currently saving each year 21.4 trillion Btus ($85.6 million at $4 per million Btu) with a Federal cost total of $34.3 million. An analysis performed in 1981 to identify factors common to projects considered to be successful found the following characteristics:

- The most significant factor distinguishing successful projects was the contractor's incentive for conducting the project. Projects that were undertaken with a market/sales objective generally proceeded more rapidly to market introduction with fewer cost overruns. Specifically, many of the more successful projects were undertaken by constractors seeking to develop a product that they intended to sell.

- The type of contractor that tended to be most capable of bringing a technology to the market introduction stage was a large, technically competent, well-respected, and innovative equipment manufacturer. Moreover, projects selected for funding partially based on the contractor's good reputation tended to be more successful than projects for which the contractor's reputation was not considered in the proposal evaluation.

Conversely, many of the less successful projects had these characteristics:

- The projects were undertaken by contractors whose primary interest was to perform R&D.

- Less successful projects tended to have been funded at a very early stage of research (i.e, pre proof-of-concept).

- Projects that were less successful tended to be higher risk, more innovative, and in the high-temperature process industries. However, part of IP's mission is to fund high-risk projects that have the potential for high payoff, which is typical of projects for the iron, steel, and aluminum industries. These more innovative projects are more likely to encounter cost overruns and schedule delays.

- The less successful projects tended to be those of a high level of technical difficulty that required many years of research and high risk. Many of the less successful projects had not yet reached market acceptance or had problems in the demonstration stage. As the R&D progresses, they could become more successful projects.

An important point made in this analysis, and others by the National Academy of Science, was the necessity for good technology transfer and understanding of the potential market. A technology that will fill an expressed market need, is being developed by a contractor who plans to sell the resulting product, and is cost-shared by the contractor in the Federal program is most likely to have a successful project. Where a specific industry is not developing the technology, interaction with trade associations at an early point can help insure the transfer.

Several examples of successful demonstrations include the following:

- Fumes - As-Fuel In Coil Coating: Coil coating is one of the major industries using curing processes to supply coated metal sheet for consumer products. The curing processes are highly inefficient. Significant energy losses occur because of the venting from the curing ovens of hot gases containing solvents. In 1978 a successful test was conducted on a new process developed by B&K Machinery. The process was tested by Rollcoater Inc. and was evaluated by the National Coil Coater Association in a cost-shared agreement with DOE. Fuel savings of up to 85 percent were realized. By the end of 1983 some 30 units were in operation which accounted for over 10 percent of the total market and these were initiated without Federal involvement. The process is applicable to all pre-painted materials operations. DOE's part of the $1 million project was initially $412,000 but was later reduced to $194,000 through the equipment buy-back provision of the contract.

- Slow Speed Diesel Cogeneration System: A cost-shared program between DOE, Thermo-Electron and Hoffman-LaRoche was initiated in October 1979 for the first slow-speed diesel cogeneration system in the United States. The objective was to demonstrate the technical and economic viability of the system to simultaneously provide electric power and process steam in a pharmaceuticals plant. The system began operations in November 1982, producing 23.3 mw of electricity, 160,000 pounds per hour of steam and 262,000 pounds per hour of 170°F boiler feedwater. This single installation is saving 1.5 trillion Btu's annually and 4 similar installations are being negotiated without Federal involvement. Total cost: $22,400,000. DOE Share: $8,745,000.

- Foam Finishing of Textiles: The primary objective of this project was to reduce the energy requirements for finishing fabrics by drastically reducing the water required to process wet fabrics. The project was a cost-shared effort conducted by United Merchants. The first successful test of the new process was completed in 1979. As demonstrated, the process saved energy and doubled output. By the end of 1983 some 12 billion yards of fabric annually were being "foam finished" without Federal involvement. The process not only saves energy, but doubles the output of product. Estimated energy savings currently are 3.6 trillion Btu's and by 1985 are placed at 0.01 quad. DOE's share of the cost was $1.1 million.

- High-Temperature Recuperators:

    a. Ceramic Recuperator: This project was conducted by GTE Sylvania, Inc. under a cost-shared agreement with DOE. The primary objective was to develop and demonstrate the functional capability of a ceramic high temperature recuperator. The first successful test was conducted in 1979. Use of the ceramic material cordierite enables the recuperator to withstand high-temperatures, in certain applications as high as 2600°F. There are 79 units in operation. Typical applications for this recuperator are in high-temperature furnaces used by steel, aluminum, glass and other heat treating industries. Estimated annual savings by the year 1985 are placed at 0.06 quad. DOE's cost for this program was $2.6 million.

(b) Metallic Recuperator: This project was conducted with Garrett AiResearch under a $3.2 million cost-shared arrangement. A compact unit handling 10,000 SCF/H flow at 1500°F with fuel savings of 33 percent was demonstrated. This recuperator has wide application in aluminum remelt, steel heat treating, steel forging, box annealing processes. A total of 20 units are operating and 63 units are in the process of installation. Estimated annual savings by 1985 are 0.02 quad.

The last two projects were intended to be tested at various host sites in 1979-80 with the objective of accelerating the implementation of the technologies. Implementation of multiple demonstration sites did not go as rapidly as intended due to procurement problems. These products are penetrating the market through the private sector and it is questionable whether multiple testing gave them a boost. Tests in various environments widen the private markets, but in most of the industrial programs a single representative, full-scale demonstration appears adequate for technology transfer.

However, the amount of R&D sufficient to reduce uncertainty in the private sector varies. For example, a technology for the hot inspection of steel was successfully tested on a part of one side of a hot slab. A seminar was conducted to review the results with steel industry representatives, but there were no takers. Potential users want to see results of tests on both sides of a hot slab - which requires further Federal-supported testing of a full-scale system.

Energy use in the industrial sector is dominated by the ten most energy-intensive manufacturing industries, which account for 78 percent of total use. Projected fuel and electricity use in the year 2000 indicates that certain industry groups are expected to grow more rapidly than the industrial sector as a whole. These include chemicals; stone, clay and glass; machinery, other manufacturing industries; and non-manufacturing industries. Primary metals, textiles, petroleum, and fabricated metals and petroleum will probably be slowest. Part of this expectation is due to the increasing dependence on foreign sources for strategic materials or manufactured equipment and final products. Much of the improved processing used in traditional industry has come from foreign sources. The U.S. must make a decision as to whether the "smokestack" industries are to remain here and if we are to manufacture our own textiles, steel, aluminum, or are we to purchase "off-shore" and become more of an information economy? Should the objective be to have American industy in the forefront of manufacturing in traditional and new industries, the cost-shared development and demonstration of energy-efficient processes and waste energy reduction technqiues must be continued. The recent expansion of the thin strip steel casting project to the demonstration phase is an example. This project will increase the productivity of producing metal strip and, if energy efficiency improvements are proven through laboratory-scale experiments, a joint industry-government, pilot-scale test should be undertaken.

Buildings and Community Systems

Residential and Commercial buildings used approximately 25.5 quads of primary energy in the U.S. in 1983. While energy demand by this sector has changed little over the past ten years (24.2 quads in 1973), the percentage of national energy consumed by buildings has risen from 33 percent in 1973 to its present 36 percent. A recent study by the Office of Technology Assessment of buildings in cities concluded that only 38 percent of the energy savings achievable by investments that are economically justified under present conditions of capital, retrofit information, and public program will in fact occur by the year 2000. The building industry, both in its construction and operation, is extremely fragmented and hard to reach in any single coordinated series of activities and is less responsive than the other sectors to rising prices. The risk of nonperformance or subperformance can be large to the architect, engineer, banker, and developer. The design practice is based on what works, which translates to what the designer has direct experience with either in his own practice or from peer sources. The rate of diffusion of new design, construction, and technologies is slow. Studies have shown that the level of privately sponsored research and development in buildings is less than in the other end-use sectors.

Like the industry program, there have been successful buildings conservation demonstration programs that have led to new products being introduced into the marketplace and new methods to audit and retrofit existing buildings. The building equipment area has funded some of the most successful demonstrations. One, the cost-shared development of the first successful heat-pump water heater, created a new industry. The heat-pump water heater is an appliance that uses the refrigeration cycle to heat water and requires only half the electricity of conventional resistance heating. Two small companies were funded by DOE for the development of the integrated heat-pump water heater, market development, field demonstration, and testing ($734,000, DOE; $200,000, EUS, E.Tech.). The full-scale demonstration included several utilities agreeing to purchase and install at least five models and collect data in a uniform manner determined by scientists at Oak Ridge National Laboratory. As a result of those tests and the data obtained and published by ORNL, the two small manufacturers decided to manufacture the heat-pump water heater. By the end of 1982, there were 11 manufacturers listed in the GAMA directory. The larger manufacturers who began to produce the product stated that they did so as a result of the DOE test data. Consumers are not purchasing them as quickly as anticipated due to the higher first cost.

Other successful Federally sponsored demonstrations have led to the introduction of a high-efficiency refrigerator-freezer which is 40 percent more efficient than the previous ones being made, solid-state lighting ballasts, advanced oil burners, and an advanced motor-compressor for refrigeration. A demonstration that succeeded technically, but has not achieved commercialization is the Annual Cycle Energy System (ACES) house. Higher first costs and stable energy prices have thus far discouraged its acceptance by the marketplace.

In addition to conducting technology demonstrations in the buildings area, it is important to conduct demonstrations that will lead to removing the institutional barriers that exist. DOE should continue to investigate innovative financing, information and ownership programs that were conducted in the past. A demonstration project in New Jersey showed that a one-stop shopping concept combined with innovative financing can work. Arrangements were developed for an energy services company to provide no-cost (to the consumer) audits and retrofits on 1,000 houses (one-third all electric, two-thirds gas heated homes) located in Lakewood and Jackson townships in central New Jersey. The consumers participating in the demonstration included a retirement community (all electric) and a township representative of the area (blue collar families, homeowners with median income of $21,000, housed in single, detached houses). The energy services company contracted with the utilities to sell them "saved energy" resulting from the retrofits. The contract stipulated that only energy actually saved would be paid for by the utility. Several important findings emerged. There was considerable interest in the program exhibited by the community. The retirement community, for example, heard about the program and actively sought to participate. Several meetings were held to explain the program with little money spent on an extensive household-to-household marketing campaign. In fact, within several days of the follow-up meetings, nearly every household in the retirement community had signed up for the service (and the energy services company had to expand the number served).

Although the savings were not as high as projected, there was a 10 percent reduction in utility bills. Most notably, households were satisfied and noted an improvement in their comfort level.

While there were start-up lessons learned in Lakewood on the need for quality control in retrofit installations, the important finding was that the concept could work. The company which participated in the demonstration (putting in one-third of the funds) and two other companies and the utility have signed contracts for additional projects.

Shared savings or performance contracting approaches in which building owners are not required to capitalize the energy-efficiency improvements as a contractor or third party capitalizes the investments, has become a new method to finance retrofit of buildings, particularly institutional buildings (schools, hospitals, not-for-profits, government buildings). There are now at least 75 energy service companies. In 1980, there were fewer than 10. Several of the companies offering shared savings, particularly for smaller buildings (less than $50,000 yearly energy costs) state that they were able to develop business-as-usual agreements and lease arrangements based on model agreements developed by the DOE program. The development and testing of model "paper" tools and other innovative institutional and organizational arrangments is as important as testing out actual hardware.

In the community systems area, DOE in the past had provided funds for feasibility studies and preliminary design for integrated community energy systems and district heating. Several of these have gone forward to construction without major Federal dollars (Trenton, St. Paul). Without the front-end DOE support, however, they would not have proceeded. Although these grants are not demonstrations per se, they are an important Federal instrument, relatively inexpensive (less than $1.0 million for district heating feasibility studies in

28 cities), to accelerate the introduction of energy-efficient delivery systems at the community level.

Space heating and cooling are the major uses of energy in the building sector, with water heating important in the residential sector and lighting in the commercial sector. Energy use projections for the year 2000 indicate energy for space cooling will increase the most, with some increases in water heating and decreases in space heating and lighting. Thus, research and demonstration in the next decade needs to continue to focus on space conditioning, equipment, and water heating, and refrigerants in addition to institutional and information questions. Multifamily and commercial building energy-efficient technologies and their implementation have received less attention than single-family residential buildings.

One technology that has been federally funded for several years but has been found to be more difficult technically than initially anticipated, has been the thermally activated heat pump. In the U.S. there are 40 million single-family residences which utilize gas as a source of heating fuel. Thermal heat pumps could burn conventional fuels such as natural gas to produce space heating and cooling at efficiencies twice that of the best possible combustion furnace systems. Several systems - absorption systems, free-piston Stirling engine systems, free-piston internal combustion engines - show a good potential of providing the reliable, long-life, high-efficiency operation required of heat pump systems. Based on the relatively early stage of development, it is not evident which technology has the highest probability for long-term success. The current DOE program has been refocused with emphasis on supporting technology research with some proof-of-concept testing. These are long-term, technically and economically high-risk programs; thus it would be appropriate to pursue joint Federal-private, multiple research program paths, multi-year planning and commitments with clear milestones leading to some multi-unit demonstration. In addition to developing laboratory and field unit prototypes, it is necessary to have on-going supporting research on materials, fluids, dynamics, and mass and heat transfer.

Although not a demonstration, per se, in that the Federal government is not paying for the design and construction of new energy-efficient innovative residential and commercial structures, it is important to obtain information and data as to how these buildings and their systems operate both technically and economically with respect to their design specifications, how the various subsystems interact, and how the occupants respond to these new buildings. Data then needs to be analyzed and results conveyed to architects, builders, developers in formats they understand to accelerate widespread adoption of the most successful and energy-efficient designs and practices. Some residential data is collected through the LBL-BECA system and an effort has recently been initiated with the American Institute of Architects Foundation to do post-occupancy evaluation of lighting in office buildings, but there is no comprehensive data collection system.

Good engineering data not only should be obtained for new buildings, but there needs to be an emphasis on the retrofit measures for multifamily and commercial buildings. In addition to the technologies, methods to accomplish the retrofits, particularly with multifamily buildings, need to be demonstrated. For the next 20 years, retrofits are going to continue to be important, but there is little documentation of the cost-benefit of specific measures or the interactive effectiveness of measures except in single-family housing.

In the buildings area, the Federal government can use its own facilities to demonstrate new technologies, new approaches, and support production through government purchases. The 1983 Energy Research Advisory Board report on Conservation made several worthwhile suggestions. In addition there has been much talk, but little action, on shared savings programs for Federal buildings. These could be funded with or without Federal dollars.

Transportation

The transportation sector consumed 27 percent of the nation's energy in 1983, but 61 percent of the nation's petroleum. Ninety-seven percent of the energy used in this sector is in the form of petroleum products. This sector's share of petroleum use has risen 10 percentage points during the past decade. The sector is much different than the other two in that it is a concentrated industry and there is a relatively rapid turnover of the products. It has been dramatically impacted by imports. As a result of the Corporate Average Fuel Economy Standards (CAFE), the efficiency of automobiles has greatly improved in the past decade. The DOE program has focused on longer-term options. The two major programs: advanced heat-engine development and electric and hybrid vehicle development program gains are relevant to the question of today's hearing.

In 1975, the Jet Propulsion Laboratory completed an analysis of alternative automotive power plants for possible introduction during the 1980 - 1990 time period. Congress passed the Automotive Propulsion Research and Development Act of 1978 (Title # III, PL 95-238) which laid the foundation for a long-term (5 years), joint industry-government preproduction, proof-of-concept engine development program. Industry, would then on its own provide the capital to retool for production and design. The program has focused on the development of advanced automotive gas turbine and Stirling engines for light-duty vehicles and uncooled, minimum friction diesel engines with integrated waste heat recovery for the heavy-duty transport sector. Parallel to the engine development programs has been a research program on key technologies with specific emphasis on ceramics.

In 1979, two gas turbine development programs were initiated - each to cost $60 million and each cost shared. The two programs which complement each other were awarded to Ford-Garrett Corporations and two divisions of General Motors (Allison and Pontiac). Each of these programs involves the design, development, and testing of advanced automotive gas turbines incorporating ceramic components. Ceramic parts have been made, characterized, and qualified at temperatures up to 1100°C and spin tested at greater than 100,000 rpm. The ceramic development has focused on proof-of-concept ceramic parts operating under automobile application conditions. Although a commercialized ceramic gas turbine engine is probably a decade away, ceramic turbochargers are being evaluated both here and in Japan for introduction within the next two years. In the U.S. the ceramic turbocharger work is being done without Federal funds but it is utilizing knowledge gained in the Federal program. While the development project has been very successful, and did provide a focus for ceramic component technology, two years ago it was recognized that additional fundamental research activities would be required before an industrial technology base was established which would allow future production of reliable ceramic components commercially. A parallel basic research program was initiated which is investigating the areas of ceramic materials and processing, design methodology, and data and life prediction. Thus, there has been both a long-term commitment to a proof-of-concept technology development (with some modifications) and the continuing supporting research. The proof-of-concept development program has been reviewed and monitored carefully by DOE and NASA (NASA has been the program development support for DOE), and the basic materials program has been developed and monitored by DOE and ORNL. Both programs have reached the milestones scheduled with funding available. If there had been a focus only on basic research with no identified product or only on the proof-of-concept product concept, it is unlikely that we would even be in the competition with Japan today.

The Electric and Hybrid Vehicle Program was established as a result of the Electric and Hybrid Vehicle Research, Development and Demonstration Act of 1976 (PL 94-413). This Act required the government to subsidize the deployment of 7,500 electric vehicles with 2,500 in FY 1978 for the first three-year period and 5,000 spread over an additional four-year period. The Act was subsequently modified to stretchout the purchase of the initial 2,500 vehicles over a three-year period. There was a parallel requirement in the Act for development of improved technology in battery and propulsion systems. From 1979 to 1981 about 1,100 vehicles were purchased, mainly from four small business manufacturers, with loan guarantees for two companies, who replaced the existing internal combustion engine with electric drive systems and batteries. It is in the national interest to develop electric vehicle technology as electricity can be generated from more abundant fuel sources and EVs can be a real alternative for switching from petroleum. The large-scale demonstration of 2,500 new technology vehicles as provided for in the original legislation was recognized by Congress as being premature and after an oversight hearing on P.L. 94-413 was amended to stretchout the procurement over a three-year period to permit new technology to be incorporated into the later year procurements. In FY 1981 it was then agreed to phase out the large-scale demonstration of existing technology vehicles and concentrate on developing battery and propulsion system technology and emphasizing the testing and evaluation of new technology in vehicle fleet operation. In hindsight, the large 7,500 vehicle demonstration was premature and the emphasis on technology development should have preceded any large-scale demonstration. Prototype vehicles should have been designed as was the ETV-1 and ETV-2 and built and tested at appropriate stages in the technology development with joint participation by industry. There have been successes in this program particularly with advanced lead-acid, nickel-iron, zinc-bromine and sodium-sulfur battery development with joint government-industry funding of the development and commercialization planned by industry alone. Significant drive train advances have been made with an A.C. system developed by Ford Motor Company for lighter weight and more efficient operation.

The automobile has been the major user of transportation energy and the focus of energy conservation opportunities. By the year 2000, projections indicate that energy use by trucks is expected to be as large as that for automobiles; thus the program in the next decade should look at technology development opportunities to make light and heavy trucks more energy efficient and capable of burning many fuels. These cannot be downsized in the same manner as automobiles. Some of the heat engine technology is applicable to trucks and some programs have been initiated using ceramics and other technology but these need to be evaluated and long-term joint development programs considered and implemented.

The electric vehicle program has been focused on a technology and system development program. However, a new consortium called the Electric Vehicle Development Corporation (EVDC) consisting of utilities, the Electric Power Research Institute, and others has been established to commercialize the electric vehicle technology under development by DOE programs.

Participation by DOE in developing the technology in cooperation with EPRI and in assisting the testing and evaluation of new technology vehicles for eventual deployment by EVDC would accelerate decisions being made on what are the appropriate applications for electric vehicles (fleet, personal use; vans, automobiles) and field testing of best-available technologies.

The Office of Energy Systems Research has several efforts which are not demonstration, per se, but are facilities which encourage joint industry, government, and university activities. These have been jointly funded. In one case, the Battery Energy Storage Test facility (BEST) was funded by DOE, EPRI and New Jersey Power and Light. The combustion laboratory at Sandia, though built with DOE funds, has corporate-sponsored scientists there. The new high-temperature materials laboratory at Oak Ridge National Laboratory will function in a similar way. Technology transfer occurs when people communicate with one another and those facilities - which are used to test new technologies or understand basic phenomena - enable that process to occur.

Types of Demonstration Programs

Up to this point, I have discussed, through case studies, the "traditional" types of demonstration programs where a technology is developed and tested in a "real" life application. Most of these have been cost-shared between government and industry. I do not recommend that a specific fixed formula be used; e.g.,25 percent private funding for applied research, 50 percent for development, 75 percent for demonstration. Each sector and industry has its specific needs and constraints. However, as the technology moves from one development phase to the next, and the risks become reduced, the share of private sector cost-sharing should increase. The appropriate level of cost-sharing would be determined on a case-by-case basis and be influenced by such factors as: the ability of the proposer to share; the vested interest of the proposer; the residual rights required by the proposer, and the level of risk of the project. Innovative pay-back schemes - such as refunding funds from savings occurred (e.g., coil coating) or royalty payment to the government from a certain number of sales until the Federal share is reimbursed.

Should demonstration money come from annual appropriation as it has to date? One of the key lessons learned from the successful demonstration efforts that have led to market penetration and commercialization has been the need for a long-term, continuing commitment assuming technical milestones are met. This is often difficult to do as has been seen in the last four years. Industry could be reluctant to enter into relationships with government for demonstrations as policies are inconsistent. Federal programs are often scaled down or re-directed, and stretchout and overruns can result. Alternatives to annual appropriations with provision for oversight need to be explored. One option would be the establishment of a Conservation Technology Demonstration Trust Fund with efforts directed toward a continuing commitment to demonstration of advanced high-risk technologies to significantly improve energy use efficiency in the intermediate and long-term. There could be several funding approaches (all of these assume continuation of current research and development program funding levels with these representing additional resource requirements).

1. Set aside $1.0 billion and according to established guidelines allocate the funds on a long-term basis to projects to be funded to completion, both technical and institutional demonstration projects. It would be a revolving fund. Funds would be replenished by pay-back of earnings from successful projects.

2. Set aside $1.0 billion, but use only the interest from such a source, with demonstration projects funded annually, but the interest to fund further years upon completion of successful milestones. The fund would be replenished as in other programs.

Other mechanisms which can encourage demonstration but not be direct budget financing would be:

1. Insurance program - government provides insurance if a manufacturer or business loses sales or production as a result of "down time"" due to a new technology or process being tested. This program could prove a disincentive to some industries obtaining success. This would not be useful for design and construction of innovative buildings, as once a building were built and occupied, one could not relocate the occupants.

2. Loan guarantees - although these have not proved successful for technologies that were not ready for demonstration they may be useful for establishing or demonstrating new finanacial arrangements that provide funds for the user to implement energy-efficient technologies. Another financial instrument that could be tested would be zero coupon bonds to handle the initial cash flow problem.

3. R&D limited partnerships but with the government willing to contribute capital for the demonstration of high-risk technologies.

The management of these programs should be within the existing conservation program and not a separate entity. There should be an outside advisory board consisting of representatives from large and small business, financial institutions, utilities, universities, etc.

What is needed is an analysis of the types of mechanisms that have been used in this country, Europe, and Japan - both private and public mechanisms - to introduce new technologies, not just energy-related ones - and new ones not used and determine the most effective means for complementing the market signals and ensuring that the U.S. continues to move to a more efficient society.

There have been some international comparative analyses of financial and fiscal incentives for industrial energy conservation research, development and demonstration and an inventory of international development assistance for conservation projects. These studies have found that countries such as Japan, West Germany, France, United Kingdom, and Sweden have aggressive demonstration programs for energy-efficient technologies, but also subsidies for their adoption. Options are given. For example, the United Kingdom will provide funds for 50 percent of a demonstration's cost, with the recipient required to repay with savings or sales. They will give as an alternative a 25 percent grant with no repayment requirement. Most of industry takes the grant. There are also funds provided by foreign countries for demonstration of technologies in other countries, e.g., developing countries. These are not "first-of-a-kind" demonstrations, but the testing of systems or equipment in different situations to help create an export market for their products.

In conclusion, the DOE end-use conservation programs have had successful demonstration projects which have led to market acceptance of these technologies. These programs complemented the market signals, accelerated the introduction of technologies, and helped maintain our competitiveness in a world market. Progress has been made in energy-efficiency improvement, but there are additional opportunities to save. We live in a world of intense international competitiveness and need to ensure the conversion to an efficient energy and economic economy, have secure and alternative energy at affordable prices, and ensure having technologies available and ready to use in an emergency situation. There must continue to be a Federal-private partnership in demonstration of the end-use technologies and implementation strategies.

Mr. FUQUA. Thank you, Dr. Savitz.

I think we'll go ahead and hear from Dr. Straughan, and then we'll maybe ask both of you questions at the same time.

Dr. Straughan, we're very pleased to have you here this morning.

Dr. STRAUGHAN. It's my pleasure to be here, Mr. Chairman. And I would like to submit my written testimony for the record and summarize.

Mr. FUQUA. Yes, we will make that part of the record and, if you wish to summarize, that will be acceptable.

Dr. STRAUGHAN. Let me clarify from the outset that I think that the renewable, including solar, of course, technologies, the demonstration phase, as I shall define it, is an essential step in the process of research, development and commercialization.

I feel the problem lies somewhat in the various definitions of demonstration. And I'd like to clarify what I include when I use the term "demonstration." The research, development and demonstration process, RD&D, varies—the definition thereof—varies from company to company and from agency to agency. But it's basically a continuum with basic research at the beginning which moves into applied research where the scientific knowledge is further developed and potential uses of the technology are identified. It moves forward again into a number of developmental phases which start to focus the efforts on a particular applicational product, and manifests itself in laboratory-style hardware prototypes and some pilot-style tests.

The next and final phase of this process is that of demonstration. And I—as I define it, it is the verification of technical and economic feasibility through the design, construction, test, and evaluation of large-scale systems or modules under real operating circumstances.

The proof-of-concept idea has been used for different phases of RD&D in—for different technologies, from proof-of-concept of the technology that it works with no regards to its economic viability all the way up to commercial acceptance, as being included in that definition. And because of the breadth of that definition, I think it's almost a useful—useless phrase.

I think it's interesting to know that, within the Department of Defense, the demonstration phase is called test and evaluation and, therefore, we have RDT&E rather than RD&D. And this serves the same purpose as a demonstration, but it's not, it's not suffered from the confusion with commercialization because DOD tends to feed upon itself or consume its own technology.

The market for energy technology, on the other hand, is a much more conservative market and, like the man from Missouri, you got to show me before I buy. And in the energy market, we feel that it's necessary for the economic as well as the technical viability to be proven before industry will come belly-up to the bar for the next phase of development.

I think that we've had successful demonstrations in the past, and the activities that we've seen funded by the Federal Government in the past have been in—with some demonstrations, in harmony with the proper definitions and functions of pilot and demonstration phases of RD&D. Characteristics of these phases usually include—and I think this is important—less than optimal size and design, first-of-a-kind scale-up applications, high initial cost, intensive instrumentation, and unknown or poorly defined parameters such as facility life, efficiency, reliability, O&M costs and operation requirements. So that this doesn't fulfill the final demonstration role of being able to cap all the—these economic variables.

The second category of demonstrations in the past included multiple applications, often nationwide, as Dr. Savitz has just mentioned with electric vehicles, of a technology oriented toward stimulating or accelerating commercialization of that technology. This market pull category was, in fact, clearly not a true application of the demonstration phase, and not only drew needed research and development funds from their proper function, but often did not accomplish their stated goals. We are certainly not advocating a return to Federal funding of this second truly commercial category of demonstrations, if you will.

But the pendulum swings and the net result of past overemphasis on commercialization in Federal demonstration programs has resulted in a trend to overcorrection. Specifically Federal funding has been withdrawn or severely reduced for what we think are needed development and demonstration activities. If you will, the commercialization pox killed albatross and swan alike.

Irrespective of from whence cometh up the funds, there is a need for appropriate demonstration activities. Effective demonstration projects take the technology out of the laboratory and operate it in a real-world environment where unforeseen or unresolved technical and performance issues can be identified and addressed. In addition, true demonstration projects verify the predictability of cost of the technology.

Demonstration projects also have important spinoff benefits which include the training of installers, operators, and technicians, the establishment of standards and testing methods, and the development of needed data bases. This ensures the real payoff of a successful research and development program rather than having research and development be justified as an end in itself. Although science is "a glorious entertainment," Sir Francis Bacon once said, "The sure and lawful goal of science is none other than this: That human life be endowed with new discoveries and life." Research and development are justified only when they are transferred via proven technology into results which benefit our society. Demonstrations, in my opinion, are the means by which technology is transferred from the laboratory to society. If Sir Francis were addressing this subcommittee, he might say, without demonstration, technology transfer is mere idle gabble.

In this Olympic year, let me use an analogy of a four-lap relay race proffered by Dr. H. Hubbard, the Director of SERI. The goal of the race is not to completion of any single lap, but the successful completion of all the laps, finishing the race. In the past, the technology race has been run by both Federal laboratories and industry, each running the laps consistent with their charter and resources. In the area of renewable energy technologies, as with other technologies, the Federal role was to run the early laps and hand off the baton to industry which could run the final lap. Under current policies, the Federal laboratories tend to be running laps one and two, and industry is expected to add lap three to its agenda as well as the historic final lap four. Although industry has been able to raise—rise to the challenge in some areas, we find that in the renewable area, the renewable is indeed unique in that the industry, the user industry at least, is capital intensive, and venture capital or corporate risk-taking is not tuned to fill this void. As a result, we find the baton lying on the ground at the end of a well-run first two laps with the fourth lap runner already warmed up but unable to reach back for the baton—the investment wasted and the race unfinished.

I feel strongly that large-scale demonstration projects form the critical third lap in our race to apply renewable energy technologies to meet energy—national energy needs. I also believe that the perceived obstacles to renewable energy technology can be removed by well-managed federally sponsored incentives and projects. This critical lap between R&D and commercialization can be run as a partnership between Federal agencies and private industries. Although the argument can be made that this constitutes some duplication of effort, I return to the analogy of the relay race to point out that the most efficient method of transferring the baton is for both runners to run side-by-side over some overlapping distance. I can assure you that if you look at other competing countries engaged in this same advanced technology energy race, you won't see their batons lying on the ground.

I think that for this third lap to be run successfully, the pro—the demonstration projects must be dealt with on a case-by-case basis as indicated by the witness from DOE. And I think that we need to critically examine the criteria by which the demonstration projects are collected. I think the important concept is that the relationship between Government and industry in the energy technology era is a proven one, and it's based on the concept, the whole is greater than the sum of the parts.

I thank you for the opportunity of sharing this perspective with you, and I am prepared to answer any questions.

[The prepared statement of Dr. Straughan follows:]

Prepared Testimony

of

DR. IAN R. STRAUGHAN
Director of Research and Development
Southern California Edison Company

CONCERNING FEDERALLY SPONSORED DEMONSTRATION PROJECTS

Before the
Subcommittee on Energy Development and Applications

of the

Committee on Science and Technology

of the

United States House of Representatives
Washington, D.C.

June 13, 1984

Good morning, Mr. Chairman and members of the Subcommittee. It is indeed a pleasure for me to appear before you to discuss the need for, and proper role of, federally sponsored demonstration programs.

I am Ian R. Straughan, Director of Research and Development of the Southern California Edison Company. My responsibilities include the implementation of strategies, plans and actions to accelerate the development, demonstration and commercialization of emerging energy technologies.

Let me clarify at the outset that, I feel due to the unique characteristics of renewable technologies, the demonstration phase for this is an essential step in the research and development process. The problem, I feel, lies in the proper definition of "demonstration." To be more specific, let me clarify what I consider to be included when I use the term demonstration. The research, development and demonstration process definition (RD&D as it is often referred to) varies from company to company and from agency to agency, but is basically a continuum that begins with Basic Research or the development of scientific knowledge, moves into Applied Research and Exploratory Development where the scientific knowledge is further developed and potential uses of the technology are identified, and moves forward again into several advanced development phases which start to focus the efforts to a particular application or product and begins to manifest itself in laboratory-scale hardware, prototypes, and some pilot-scale tests.

The next phase in this process is that of demonstration and is defined as the verification of technical and economic feasibility through the design, construction, test and evaluation of large-scale energy systems or modules in operational circumstances.

It is interesting to note that within the Department of Defense, the demonstration phase is called Test and Evaluation (RDT&E) and serves the same purpose but has not suffered from the confusion with commercialization because DOD tends to consume its own technology. The market for energy technology, on the other hand, is formed only when reliable and fully tested technology is available. In other words, the energy sector may be compared to a young man from Missouri. You must "show me" before I buy.

Historically, renewable and alternative energy demonstration programs have fallen into two categories. The first included proof of concept and less than full-scale projects intended to prove the viability of the technology in a non-laboratory operational environment and to reduce the uncertainties associated with cost and performance. These activities were in harmony with the proper definition and function of the demonstration phase. Characteristics of these demonstration facilities usually include: less than optimal size and design, first-of-a-kind scale-up application, high initial costs, extensive instrumentation, and unknown or poorly defined parameters such as facility life, efficiency, reliability, O&M costs and operational requirements. The second category included multiple applications, often nationwide, of fully mature technology oriented toward stimulating or accelerating the commercialization of the technology. This last market pull category was in fact clearly not a true application of the demonstration phase and not only drew needed research and development funds from their proper function, but often did not accomplish their stated goals. We are not advocating federal funding for this second truly commercialization category.

From a historical perspective, many of the demonstration programs, in both categories, suffered from several shortcomings. In many cases the specific objectives and goals of the demonstration programs were unclear and in some cases the wrong technologies were demonstrated or the right technologies were taken to the field before they were sufficiently developed. It would probably be safe to say that in the earlier renewable and alternative energy demonstration programs, as many failures were showcased as successes with regard to performance and costs. Another problem inherent in some of the earlier renewable demonstration programs was the tendency to choose demonstration locations or applications not so much based on the technological needs of industry or the renewable resources available as much as other considerations. In addition, some of the programs pursued by federal programs directly duplicated activities already ongoing in the private sector.

The net result of these problems and the overemphasis of commercialization in federal demonstration programs was a trend to overcorrection, specifically, federal funding was withdrawn or severely reduced for needed development and demonstration activities. In effect, the commercialization pox killed albatrosses and swans alike.

As I mentioned earlier, there is a need for appropriate demonstration activities. Effective demonstration projects take the technology out of the laboratory environment and operate it in a real world environment where unforeseen or unresolved technical and performance issues can be identified and addressed. In addition, demonstration projects verify the predictability of cost (first and life cycle) of the technology. Demonstration projects also have spinoff benefits which include the training of installers, operators, and technicians, the establishment of standards and testing methods, and the development of needed data bases. This ensures the real payoff of a successful research and development program rather than having research and development be justified as an end in itself. Although science is "a glorious entertainment," Sir Francis Bacon once said, "The sure and lawful goal of the science is none other that this: That human life be endowed with new discoveries and life." Research and development are justified only when they are transferred via proven technology into results which benefit our society. Demonstration projects are the means by which technology is transferred from the laboratory to society.

Let me use as an analogy a four lap relay race. The goal of the race is not completion of any single lap but the successful completion of all of the laps--finishing the race. In the past the technology race has been run by both the federal laboratories and industry--each running the laps consistent with their charter and resources. In the area of renewable energy technologies, as with many other technologies, the federal role was to run the early laps and hand-off the baton to industry which would run the final lap. Under current policies, the federal laboratories tend to be running laps one and two and industry is being expected to add lap three to its agenda. Although industry has been able to rise to the challenge in some areas, we find that in the renewables area the industry is composed of a great percentage of capital intensive companies that do not always have that venture capital or corporate risk-taking ability to fill this void. As a result, we find the baton lying on the ground at the end of a well run first two laps with the fourth lap runner already warmed-up but unable to reach back for the baton--the investment wasted and the race unfinished.

I feel strongly that technology development and demonstration projects, including integrated laboratory experiments, scale-up prototypes, and large-scale demonstration plants, form the critical third lap in our race to apply renewable energy technologies to meet national energy needs. I also believe that the perceived obstacles to renewable energy technology can be removed by well managed federally sponsored incentives and projects. This critical lap between R&D and commercialization can be run as a partnership between federal agencies and private industry. Although the argument can be made that this constitutes some duplication of effort, I return to the analogy of the relay race to point out that the most efficient method of transferring the baton is for both runners to run side-by-side over some overlapping distance. I can assure you that if you look at other competing countries engaged in this same race, you will not see their batons lying on the ground.

Now let me present some of the issues that must be dealt with for demonstration projects to effectively reduce the uncertainties of technology, cost and performance.

First, the technologies must be carefully selected to ensure that they are ready for demonstration. Nothing could be more wasteful than attempting to push a technology that has not been adequately developed into the demonstration phase, that is, laps one and two must first be completed. Similarly, if there is no fourth lap runner, the third lap makes no sense. Although the demonstration of competitive technologies, systems and concepts are required to ensure the development of optimum technology, these selections must be carefully chosen with stringent criteria. It should be recognized that some renewable technologies are generally low risk, while some are high risk. In each case, support of technology demonstration activities should be made on a case-by-case basis.

Second, the projects must be a viable partnership with industry and other users (i.e., utilities, state and local governments, universities, and other federal agencies). While individually none may have the resources to run the entire lap, each has the resources and vested interest to run a portion of it. The positive impact of cost sharing by industry on the quality of research produced is substantial and provides a mechanism for eventual commercialization. This industry involvement helps ensure that the demonstration projects pursued are relevant to the needs of industry and the requirements of the marketplace. In general, the federal share of costs should be proportional to the R&D content of the project. Commercial projects should not require federal funding where a high risk project with substantial technical uncertainty may require a substantial federal R&D role.

In effect, federal sponsorship of development and demonstration projects should be in the form of government risk capital not available through the private sector, but required to develop technology for societal benefits. This government risk capital can be interjected in a variety of direct and indirect methods.

Currently, the generally accepted investment threshold for industry to be considered a cost-sharing partner in the Engineering Development phase of R&D is 20 percent. This investment, by industry, allows the key issues of proprietary rights, patent rights, and intellectual rights to be resolved early in the development phase. A larger industry share might be appropriate in some demonstration projects. I would also like to emphasize that federal support can be leveraged through cost-sharing of precommercial proof-of-concept demonstration projects and through legislative (i.e., PURPA) and tax incentives (i.e., R&D Tax Credits) and effective technology transfer.

Third, the size and duration of the projects must be carefully chosen to ensure that the return on investment, information, and technology is optimized and limited resources are not overcommitted. Demonstration projects often require multi-year time horizons and commitments. In addition, it must be recognized that the cost-sharing ratios should change over the lifetime of a demonstration project as uncertainties decrease and the benefits accrue to the users. Some control of the emphasis of the project should also be exercised to ensure a proper balance between short- and long-term objectives.

Fourth, as you may have noticed, I have talked in terms of federal sponsorship of development and demonstration projects and not necessarily in terms of federal demonstration programs. One of the benefits of a partnership with industry is that key decisions can be made based on technology and market needs thus reducing the opportunity for abuse. To help reinforce this concept, strong consideration should be given to the use of outside technical review groups to guide major programs.

There are many examples which I could cite of successful demonstration phase projects in which the federal government has been a partner with industry in the refinement of renewable technologies. These would include the Solar One Experiment (proof-of-concept) in the solar thermal technology area, and the MOD OA 200 kW large wind turbine experiment (less than commercial scale) in the wind energy technology area, just to name a few. It is interesting to reflect on where the state of the art of these technologies and the materials and components that they utilize would be today had these programs not been supported through valid federal development and demonstration programs.

In closing, let me summarize by restating that there exists today a gap in the technology development continuum between R&D and commercialization that can be filled by a combination of government and industry supported efforts. These development and demonstration programs, or large-scale experiments, are needed to ensure near full-scale system level technology readiness (cost and performance) and to bring the technology to a point where full-scale development risks are manageable within the private sector. Federal participation in, and sponsorship of, these programs must emphasize strong partnerships with industry.

The concept of a true cooperative relationship between government and industry in the energy technology area is a proven one based on the concept that the whole is often greater than the sum of its parts.

Mr. Chairman, and members of the Subcommittee, I thank you for the opportunity of sharing this perspective with you today, and am now ready to answer any questions you might have.

Mr. Fuqua. Thank you very much, Dr. Straughan.

Let me ask both of you—and you were here when Under Secretary Collins testified. He expressed concern over the Federal demonstration projects on the ground that Government is not very well suited to make what is essentially market decisions. How could a Federal demonstration project be structured that would meet the test or could achieve market decisions—not achieve, but that the Government could make market decisions from them? As a former government employee, as one in industry today, how would you do that, Dr. Savitz?

Dr. Savitz. Well, I mean, the one way of helping with making market decisions, which has already occurred, is pricing energy correctly, and so you decontrol the price of oil, and that helps the market make decisions. I think we've seen some slowdown in conservation activities because people perceive a stable energy price. People are buying bigger cars now and, even though these are more efficient than they were 10 years ago, rather than small cars because of price.

Mr. Fuqua. Uh-huh.

Dr. Savitz. But I think that, from a demonstration point of view, that by show—first, the Government can—can with industry show that a new technology or a delivery mechanism works from a technical point of view. I mean, I think what we've seen in—in some of these demonstrations at a pilot level, whether it's the treating of material by a new foam process in order to dye it in the industrial program or some new cogeneration technologies, is you see it at a scale that industry has it in its own environment. And so they see, one, a—it removes some of the technical risk, and then that—they can then pick it up and make it in their—their own market decision, and they'll see that it saves energy. There's proof that it saves energy. And then they can make the investment.

It also has to be economic, and that is so many—depends upon so many factors. What we're finding in the heat-pump water heater, which was a technology that was—was developed and demonstrated using two small companies, doing jointly with the Federal Government and these companies, and testing by utilities of 100 units, a very limited number, major manufacturers got into it—Fedders, Carrier, Lennox—because they sold the data that these were—they did work reliably, first of all, and that, second, that they could make them at what was thought to be a competitive price. What they're seeing, even though they're being made now, there are not a lot of sales. They cost twice as much as a standard water heater, but yet the price of electricity hasn't gone up as much in the last few years, so the purchaser is making decision on current costs.

Yet, that was a successful demonstration from the point of view industry say that it worked, worked reliably, and they then saw that there was a potential market. Now whether industry's re-evaluating that position, that's something one has to see.

Mr. Fuqua. How about you, Dr. Straughan?

Dr. Straughan. I think that the way to go about it is in a partnership. Now if we start at the top end where the—where there is zero technical risk, there has been proof-of-concept that the technology works and there is only economic risk, then industry views their economic risk based on what my return on investment; the higher the risk, the higher return on investment that I require.

Well, if they—industry can see a market in the future, then it's prepared to take on the demonstration as a sole industry operation as a loss leader because it will recover its investment down the road.

Now, as the technical risk increases, the industry reaches a point where the return on investment just isn't worth the risk, and that is where I believe a partnership with the Federal Government adding funds to, if you will, the limited partnership pie to overcome the investment need such that the industrial partners will have reduced their investment and thereby increase their return on that investment to a point that's acceptable.

Mr. Fuqua. Now, let me ask you a more specific question, one we've mentioned earlier about the new solar project that your company is considering.

Dr. Straughan. Yes.

Mr. Fuqua. Now, the Government participated in Solar I.

Dr. Straughan. That's right.

Mr. Fuqua. Do you think it should participate in the other, or would tax credits or other incentives assist the company to do that? The technology has been proven——

Dr. Straughan. I—that's—that's where I have a difficulty with this proof-of-concept definition. There is no doubt that Solar I has been a successful experiment and—and proving the concept of solar central receivers. But it is not a commercially viable operation with the system as it exists in Solar I today.

Mr. Fuqua. Yeah.

Dr. Straughan. We have to take the next step.

Now, we have tried diligently, believe me, with other industrial partners to bridge the gap all the way to commercialization.

Mr. Fuqua. Uh-huh.

Dr. Straughan. And we've looked at trying to develop a return on equity that would be suitable. We have looked for additional contributions from our ratepayers to help fund the full step to commercialization. And this is a very difficult task and, to date, we have not been successful in getting that put together.

You know, what would be an alternative is that we go to a demonstration phase for solar central receiver technology utilizing the proof-of-concepts technically that have been developed both at Solar I and Sandia Labs in Albuquerque and move to some form of molten salt demonstration phase that would remove the risk of the commercial type technology and thereby lower the need for return in investment that industrial investors would have.

Mr. Fuqua. Now what size are you talking about for this facility? As I understand, the discussions are centered around from 100 to 150 megawatts.

Dr. Straughan. The discussion has centered around 100 megawatts for larger—100 megawatts because that's the minimum size at which the operation and maintenance costs can be amortized over a plant that make it economic.

Mr. Fuqua. Yes

Dr. Straughan. So that to make——

Mr. FUQUA. So, you're saying then approximately 100 megawatts to demonstrate the molten salt?

Dr. STRAUGHAN. A 100 megawatts to make it a commercially viable operation.

I think to demonstrate molten salt and remove the risk from going to the 100-megawatt size, the technical risk, it could be at—could be done actually at Solar I.

Mr. FUQUA. That's what I—my next question. Could it be modified——

Dr. STRAUGHAN. Yes, yes.

Mr. Fuqua [continuing]. To test that rather than the way you're using rock and oil right now.

Dr. STRAUGHAN. That's right. We could repower——

Mr. FUQUA. Yes.

Dr. Straughan [continuing]. Solar I to a——

Mr. FUQUA. And it would be much less expensive—

Dr. STRAUGHAN. That's right.

Mr. Fuqua [continuing]. Because you already have the panels. All you are doing is testing the storage capacity.

Dr. STRAUGHAN. That's right. It would be much less expensive——

Mr. FUQUA. Yes

Dr. Straughan [continuing]. But it would not be commercially viable for us to take on.

Mr. FUQUA. Yes; I understand. But that would be—well, I was trying to determine between the 100 megawatt, were you suggesting we participate in that, or if we modify Solar I to test because it has just about completed the test phase?

Dr. STRAUGHAN. I would suggest that we would not ask that DOE be involved heavily in a Solar 100 because——

Mr. FUQUA. Commercial partnership.

Dr. STRAUGHAN. Right; but we would submit that it would be proper for DOE to be involved in the next phase at repowering Solar I.

Mr. FUQUA. But it's still part of the definition of proof of concept.

Dr. STRAUGHAN. To me, yes.

Mr. FUQUA. Yes. I would concur with that.

Dr. Savitz, you mentioned $1 billion for the proposed conservation technology demonstration trust fund. How did you arrive at that little round number?

Dr. SAVITZ. I just picked it out of the air as any number. And, as I said, one could work it two ways. One, you could just say take the interest off of it, and it's 100 million or 150 million, and fund projects at a year-by-year basis, or one could say you're going to commit yourself to a major development program, let's say, of a better heating and cooling device and fund the whole thing up front, so that you know for 5 years there's funding there, so it's like sort of putting the money in the bank to obligate the money and—if it's there.

But there's been no real analysis in the last few years of—similarly to what we did 10 years ago as to what are the technological options, you know, what do we see is going to be the future 10 years, and where should the efforts be. There's some looking at data as to how much modes of energy use are changing. So I think that analysis has to be done before one comes up with any specific number.

Mr. FUQUA. Mrs. Schneider.

Mrs. SCHNEIDER. I'm interested in knowing from both of you what you believe to be the relative merits of tax credits and other indirect forms of Federal support versus direct cost sharing on development and demonstration?

Dr. SAVITZ. The Congressional Budget Office just released a study in April, and the National Science Foundation's done a study, and they're sort of luke warm to negative on how useful tax—this R&D tax credit really has been.

I personally think that you need a longer term—you need upfront money that is going to be there which you don't necessarily have with the—the way the present R&D tax credit is—if you're not—if you don't have a tax liability. Many communities don't have tax liabilities, institutional facilities don't have tax liabilities, new industries don't have tax liabilities, so that they wouldn't be eligible for credit, and so that you're leaving out a whole segment of groups that even need to test out energy efficient technologies and operations, and also potentially developing new innovative technologies aren't covered.

You then don't have the same kind of focused R&D. I think that often industry, and rightly so, when it looks at its balance sheet, it's going to put R&D into products that come on the market in 2 or 3 years, and Federal programs can take higher risk, longer term projects that may not be technically ready for another 10 years, something like that. And so you won't see the technologies being developed so that, 10 years from now, they're ready to be used. It's just much—they're not as targeted as they are when you have a specific need.

Mrs. SCHNEIDER. Yes; what are your thoughts?

Dr. SAVITZ. I wouldn't disagree, but I would say that the R&D tax credits are still necessary. They may not be all that's necessary to stimulate the private sector to maintain long-range R&D programs, but without them, I think the R&D programs that have operated in parallel with and contributed cost sharing to the DOE program would not be viable without the tax credits.

Mrs. SCHNEIDER. Well, you may be delighted to know that, as of last night, we reached the over-the-halfway mark in getting cosponsors in support of the resolution for the R&D tax credits for energy. So we are on our way insofar as lobbying the conference committee.

But I'd also like to ask, since we've heard a whole lot about some of the successful cost-share demonstration projects that were funded by the DOE Office of Industrial Programs. Are there any other industrial energy efficiency technologies that aren't being funded by DOE now that you think should be funded—strictly in the industrial efficiency area?

Dr. STRAUGHAN. No.

Dr. SAVITZ. Well, one would—would wonder are some of the more—there's been reduction in some of the cogeneration technologies that—that have been looked at, particularly using alternate fuels, and I think they—they've had some successful demonstrations, the Hoffman-LaRoche Thermo-electron project, low-speed diesel. I think that those—there's still work to use alternate fuels being used for cogeneration.

And as I said, I think the country has to make the decision, are we going to continue to make our own—as I said, make our own steel, and primary metals are important. And if we are going to make our own metals, I think—and there's sort of the so-called textile or smokestack industries. We need to do efficient—develop efficient processes in these. And there's sort of one aluminum project going on now. Well, is that sufficient, or are there other technologies to be looked at? I think each technol—each of the major users of energy have to be looked at and see where still are there less efficient steps in that process, and then focus on those. I think the last time that study was done of looking at efficient processes was 5, 6 years ago, and there have been improvements made here and abroad. There is still a lot more for energy efficiency to occur.

Mrs. SCHNEIDER. Do you know who it is that's working on the aluminum project?

Dr. SAVITZ. It was a joint project, I think, with Alcoa at the time. There were at one point two projects, one with Alcoa and one with Kaiser. And I think the Alcoa one is the one that's still ongoing.

Mrs. SCHNEIDER. Uh-huh.

I guess one of the things that I find most frustrating as an advocate for energy efficiency and renewable energy resources is the slowness with which the whole process is moving. Especially when one looks on a national level as I was looking at some statistics several weeks ago. That's why my memory doesn't serve me correctly. But I think that, right now, there's a total of 7 percent of our energy is provided by renewables; is that correct? Does that sound appropriate or not, nationwide?

Dr. SAVITZ. It probably would be including wood and biomass. That's the major contributor.

Mrs. SCHNEIDER. But it seems to me as a government official we are seeking ways to provide the stimulus to get moving in that direction to have a more diversified energy base to provide greater security, both nationally and also cost-wise to the consumer. Are there any other ideas that you have or examples perhaps from other countries?

Dr. STRAUGHAN. I think at this stage it might be prudent to move slowly. I think that the initial impetus for research and development in the renewable area, of course, with the rapid escalation in oil prices which have now stabilized, I think it's given us a chance to stop and evaluate where we were going and where we should be going. And I think that if oil prices start to—to escalate, you'd see a very increased activity in the renewables area, because the economics of renewables have to be compared to the conventional systems such as fossil-fuel based.

Mrs. SCHNEIDER. Plus we have a crises mentality which——

Dr. STRAUGHAN. That's—that's absolutely correct.

Mrs. SCHNEIDER. It is quite unfortunate, particularly to those of us that like to avoid crises.

Dr. STRAUGHAN. Well, I we have to keep the effort going forward.

Mrs. SCHNEIDER. Well, you're from a utility company. I think that if we step back and look at energy and society, we can recognize rather rapidly that society has in the modern industrial age looked toward the utility companies to provide our energy direction, and also the Federal Government is saying we're looking toward utility companies to provide our energy direction. And what we are not seeing is the kind of progressive leadership coming from utilities, but rather we're seeing utilities, or some of them, taking very backward steps economically and otherwise. Perhaps now what we need to do is emphasize more local self-reliance.

Now, you as a leader among utility companies, what are you doing to educate the public, and what do you think can be done?

Dr. STRAUGHAN. Well, I cannot speak for the industry, obviously. What we are—and I think that we've endeavored to take the leadership role that you've just suggested. We produce electricity, I think, from every known method of producing electricity from—that's economically viable from renewables. And we do spend quite an effort along with our sister utilities in California to educate the public that there is a benefit to our ratepayers to be gained from generation diversity, that return to the idea of having all the eggs in one basket and subjects us to fuel supply disruptions or other political disruptions that would cut off the power. And I think that the California public at least is well informed that alternative renewable resources are an essential component of our future generation mix.

Mrs. SCHNEIDER. How do you respond to a constituent or a ratepayer who says, "Well, I've been doing everything I can do to make myself energy independent and to make my home more efficient," et cetera, et cetera, "but yet can my costs for energy continue to go up"? And I was looking at those statistics too, which were rather interesting, that even though the country has moved toward greater energy efficiency, the actual cost for energy has been dramatically increased over the past 10 years.

Dr. STRAUGHAN. Over the past 10 years, but for our company, the rates have actually gone down over the last 12 months.

Mrs. SCHNEIDER. Why?

Dr. STRAUGHAN. Because we are using less oil.

Mrs. SCHNEIDER. And more of?

Dr. STRAUGHAN. And more—well, more hydro and purchase power from coal, our neighboring utilities that have coal-fired powerplants.

Mrs. SCHNEIDER. So, then, is the lesson to be learned that diversity will lead toward reduced cost——

Dr. STRAUGHAN. No. I think——

Mrs. SCHNEIDER [continuing]. Less reliance on fossil fuels?

Dr. STRAUGHAN. I would say that diversity will lead to stabilizing costs, that the rate of increase will fall behind the rate of inflation.

Mrs. SCHNEIDER. Uh-huh. OK.

Dr. Savitz, do you have anything else to add on this or any other topics?

Dr. SAVITZ. Well, just that I think the utilities in the last few years have really—where it's in their economic interest—have promoted, you know, conservation and renewable resources which they hadn't done 10 years ago because it was not in their economic interest or not. But it's a very uneven industry. Then it depends on their economic needs and where they're located.

Mrs. SCHNEIDER. Uh-huh.

Dr. **Savitz**. But it—it has been interesting to watch the western utilities and some of the east coast and northern utilities really take active energy conservation programs and look for unique ways to inform their consumers about how to save energy, offering rebate programs to encourage more efficient appliances to be purchased even though there may be a higher first cost, and they find that's an economic route to—to meeting their supply needs.

Mrs. **Schneider**. I wonder if you could tell me what would happen to the solar-thermal program if the Federal Government does not continue to invest in it?

Dr. **Straughan**. I can't categorically tell you what would happen. But I think the most likely scenario is that there would be still some RD&D go on toward solar technologies. I think there are some solar technologies that we see would continue to move toward commercialization, but at a much slower pace.

Mrs. **Schneider**. Uh-huh.

Dr. **Straughan**. And probably virtually nothing would happen until we had the next oil crisis, and then it would all be done in one year.

Mrs. **Schneider**. OK.

Well, I think on that note, I will end my questioning. Thank you very much for your inciteful testimony.

Thank you, Mr. Chairman.

Mr. **Fuqua**. Thank you, Ms. Schneider.

Dr. Savitz, we're pleased to have you back again, and thank you for being here this morning. Dr. Straughan, we appreciate you being here. And thank you both for being here today.

Dr. **Savitz**. Thank you.

Mr. **Fuqua**. The hearing stands adjourned.

[Whereupon, at 10:45 a.m., the subcommittee was adjourned.]

APPENDIX I

ADDITIONAL QUESTIONS AND ANSWERS FOR THE RECORD

DON FUQUA (Fla.), Chairman

ROBERT A. ROE, N.J.
GEORGE E. BROWN, JR., CALIF.
JAMES H. SCHEUER, N.Y.
RICHARD L. OTTINGER, N.Y.
TOM HARKIN, IOWA
MARILYN LLOYD, TENN.
DOUG WALGREN, PA.
DAN GLICKMAN, KANS.
ALBERT GORE, JR., TENN.
ROBERT A. YOUNG, MO.
HAROLD L. VOLKMER, MO.
BILL NELSON, FLA.
STAN LUNDINE, N.Y.
RALPH M. HALL, TEX.
DAVE MC CURDY, OKLA.
MERVYN M. DYMALLY, CALIF.
PAUL SIMON, ILL.
NORMAN Y. MINETA, CALIF.
RICHARD J. DURBIN, ILL.
MICHAEL A. ANDREWS, TEX.
BUDDY MAC KAY, FLA.
TIM VALENTINE, N.C.
HARRY M. REID, NEV.
[redacted] TORRICELLI, N.J.
[redacted] C. BOUCHER, VA.

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
SUITE 2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, D.C. 20515
(202) 225-6371

LARRY WINN, JR., KANS.
MANUEL LUJAN, JR., N. MEX.
ROBERT S. WALKER, PA.
WILLIAM CARNEY, N.Y.
F. JAMES SENSENBRENNER, JR., WIS.
JUDD GREGG, N.H.
RAYMOND J. MC GRATH, N.Y.
JOE SKEEN, N. MEX.
CLAUDINE SCHNEIDER, R.I.
BILL LOWERY, CALIF.
ROD CHANDLER, WASH.
HERBERT H. BATEMAN, VA.
SHERWOOD L. BOEHLERT, N.Y.
ALFRED A. MC CANDLESS, CALIF.
TOM LEWIS, FLA.

HAROLD P. HANSON
Executive Director
ROBERT C. KETCHAM
General Counsel
DAVID S. JEFFERY
Minority Staff Director

June 19, 1984

Edward E. Noble, Chairman
U.S. Synthetic Fuels Corporation
2121 K Street, N.W.
Washington, D.C. 20586

Dear ~~Mr. Noble~~ Ed:

Thank you for your testimony before the Subcommittee on Energy Development and Applications on June 6, 1984. Attached are some additional questions that Members of the Subcommittee would like you to answer, in order to supplement the record of the hearing on this topic.

I would appreciate your responses to the hearing questions by July 3, 1984. If you have any questions regarding this request, please contact Mr. Robert S. Kripowicz, Subcommittee Staff Director, at (202) 225-4494.

Sincerely,

DON FUQUA
Chairman

DF:Kcw
attachment

United States Synthetic Fuels Corporation
2121 K Street, N.W. Washington, District of Columbia 20586 Telephone: (202) 822-6600

July 6, 1984

The Honorable Don Fuqua
Chairman, Committee on Science
and Technology
U. S. House of Representatives
Washington, D. C. 20515

Dear Mr. ~~Chairman:~~ Don,

We appreciate the opportunity to provide additional information for the record of the hearing of June 6, 1984. I trust the attached is responsive to the members' questions and would be pleased to provide any further materials, should you wish.

Sincerely,

Ed

Edward E. Noble
Chairman of the Board

attachment

RECEIVED

JUL - 9 1984

COMMITTEE ON SCIENCE
AND TECHNOLOGY

1. On page 1 of your testimony you describe the Corporation's business plan, including contracts already signed, as approximately $11 billion. What would be the effect of not using the $3.7 billion of SFC funds remaining above that amount?

The $3.7 billion is held as a contingency reserve and may also be utilized at the discretion of the Board for additional programmatically significant projects. With respect to the Corporation's basic Phase I program even though a portion is estimated rather than firm, we believe $11 billion is adequate to assist a diversity of technologies for the commercial production of synthetic fuel from domestic resources, in compliance with the objectives of the Energy Security Act.

2. What would be the effect of only funding the $7.9 billion for projects the Corporation has signed contracts with or to which you have made tentative commitments?

   a. What other options in your business plan would not be funded? What impact does that have?

The principal effect would be the severe limitation such a restriction would place on the Corporation's coal program.

Solicitations for coal-water mixture projects and for retrofit projects closed in June. Under the $7.9 billion approach, none of these projects could be funded. Further, no project utilizing Eastern or mid-Western bituminous coals would be funded. Thus, the Corporation's Phase I program would be obviously incomplete in terms of a critical resource and significant technologies which offer possibly the nearest-term and most economic utilization of coal. In addition, other promising coal technologies, for example, the slagging gasifier and the fluid bed gasifier, could not compete for funding. If Congress were to limit the Corporation to those projects currently with contracts or tentative commitments that program would be seriously deficient in the coal area and would fail to satisfy the diversity objectives mandated for Phase I in the Energy Security Act.

b. Would it make more sense to re-evaluate all current commitments at that funding level?

Were the Corporation's funding authority to be reduced to a total of $7.9 billion (which includes $400 million for Union I) - a reduction of almost 50 percent from the current $15.3 level (including Union I, but excluding Tosco) - it is likely the Board of Directors would want to reassess all of the projects with letters of intent or in evaluations. A major obstacle to doing so, however, would be the fact that various sponsor groups have been negotiating in good faith with the Corporation, many for over a year, and any reassessment at this late date would clearly be a breach of faith with industry. Such a severe reduction in the Corporation's funding authority would pose major problems and require a thorough reevaluation of the Corporation's entire programmatic strategy as balanced against its good faith obligations to industry.

3. The Administration's proposed recision would reduce funding availability to approximately $6.1 billion, including current contracts.

   a. Is there any reasonable way to allocate the remaining funding over the $7.9 billion worth of projects?

The Administration's proposed recision would reduce Corporation authority (including Union I, excluding Tosco) to $6.31 billion.

The contracted projects (Union Phase I, DOW and Cool Water) amount to $1.140 billion, leaving $5.17 billion available for assistance. One option would be to go ahead with Union Phase II and Great Plains. This would obligate an additional $3.49 billion; $1.68 billion would remain, which may be the minimum amount necessary to assist an Eastern coal project. The Board would thus have to determine whether to maintain faith and fund some of those projects with tentative agreements or to attempt to find an eastern coal project able to proceed with a minimum level of funding. It should be understood that the $6.31 amount is totally inadequate to support a responsible Phase I program.

b. Would such a reduction require you to start all over from scratch on project evaluation?

No. The basic business plan sets forth the types of projects necessary to satisfy the diversity goals of the Energy Security Act in terms of resource/technology combinations. The Board would have to reconsider its programmatic strategy against its good faith commitment to current project sponsors and determine how best to use its minimal obligational authority. In such a situation there would be little likelihood of any satisfactory compromise.

4. How long will it be before projects with tentative commitments from the SFC begin to disband?

Some projects will be forced to discontinue spending and disband their project teams by early fall; others may be able to continue limited operations into next spring.

a. Can the Great Plains partners abandon their project now?

We understand that the Great Plains partners have provided DOE with the notification required by their loan guarantee agreement which establishes the conditions upon which the parties may abandon this project. Further, it is our understanding that this notification is still in effect.

b. Do the project partners who now have no firm commitment because of the lack of a Board have any legal recourse?

The Great Plains project has received a Letter of Intent from the Corporation. This Letter creates no binding legal obligation but establishes the basic terms upon which the signatories to the Letter of Intent intend to recommend to their respective Boards the approval of an agreement for financial assistance. These basic terms include the completion of an acceptable price guarantee agreement which substantially incorporates the terms and conditions specified in a Term Sheet attached to the Letter of Intent; the compliance with certain legal requirements; and the absence of any event or the existence of any condition which, in the parties' judgment, would materially affect the financial prospects of the project. In the event no agreement is finally reached by the parties or if any party refuses to act or is legally incapable of acting, in our view, no legal recourse is available.

Similarly, the other projects which have Letters of Intent, or which have had the basic outline of an agreement approved by the Corporation's Board of Directors (called a "four corners"), have no legal recourse against the Corporation or the U. S. Government. We have made this clear by providing in our solicitations that there is no assurance that the Corporation will make any award to proposers responding to a solicitation, and by including express statements in Letters of Intent that such documents are not legally binding on the parties.

5. Is it likely that a direct liquefaction facility other than a retrofit application will be submitted to the SFC in any solicitation? Why or why not?

A proposal for assistance to a direct liquefaction facility was submitted in the first solicitation and then again in the third, but equity was never assembled for either project. The initial submission was for a plant large enough to benefit from the economies of scale and thus have a greater chance of potential economic viability, but the amount of assistance required was beyond the $3 billion limitation of the Energy Security Act. The second submission of the same project at about half the original size corrected the latter problem and retained economic viability, but the sponsors were still not able to put the required project equity together.

Examination of yet smaller plants (one quarter and one eighth the original size) by the sponsor group and the Corporation led to the conclusion that such smaller plants lacked potential for economic viability; they would not be able to continue operating after the subsidy period. These analyses also indicated that the ESA joint venture approach would not support a direct liquefaction project because the module receiving support could neither stand alone nor receive price guarantees.

Drafts of targeted and joint venture direct liquefaction solicitations were advertised but no expressions of interest were received.

With present technology, a "green-field" direct coal liquefaction plant must be in the 20 - 30,000 barrels per day range to achieve the economies of scale required to give reasonable assurance of economic viability after Corporation assistance ends. Plants of that size would require an equity investment of $800 - $1,000 million. An equity investment of this magnitude, couple with substantial remaining technical risk, makes it now appear unlikely that a commercial scale "green-field" direct liquefaction plant will be built nearterm.

However, there is indication of continuing development which may resolve some of these problems. One of these surfaced in a potential retrofit proposal which reduced costs by using portions of an existing facility and refinery and improved output by gasifying all the heavy, low value liquids. This proposal was not submitted in either the recent retrofit or fourth general solicitation, but a new Board may wish to consider it further.

6. Please define these terms, noting their similarities and dissimilarities, and describing the needs for each type of facility:

   a. process development

   b. pilot plant

   c. semi-works

   d. demonstration plant

The Department of Energy's use of these terms differs somewhat from industry's. Mr. William Vaughan, Assistant Secretary for Fossil Energy, U. S. Department of Energy, defined these terms as currently used by DOE in his written testimony for the Subcommittee on Energy Development and Applications dated June 7, 1984. I repeat that portion here as a base line:

"In presenting its FY 1982 and subsequent budgets to the Congress, the Energy Department's Office of Fossil Energy depicted the development path for advanced coal, petroleum, oil shale and unconventional gas technologies as having five major stages:

- basic research -- involving the development of scientific knowledge;

- applied research -- involving broad engineering and physical science aspects of specific energy technologies;

- proof-of-concept -- the stage where sufficient knowledge is obtained to establish technical viability and basic engineering feasibility and to permit initial forecasts to be made of a technology's economic and environmental performance.

Question 6., Continued

- process development -- involving increasingly larger scale systems to reduce technical risks and refine process operability, reliability, economics and environmental performance.
- commercialization -- where market-driven decisions are made to deploy full-scale modules or commercial plants employing new technology.

"A given technology may require several scale-ups between 'proof of concept' and commercial scale. The terms 'semiworks' and 'pilot plant', therefore, do not always define a specific scale that can be applied across the spectrum of fossil energy technologies. 'Semiworks' and 'pilot plants' may be the same for some projects; in others they may differ. In general a 'semiworks' facility is generally the last step in scaleup to a commercial size plant. We have attempted to make the distinction between 'pilot' and 'semiworks' facilities where it applies in the following descriptions of specific fossil energy technologies."

The following definitions would be more likely used in industry:

Process Development is that step between basic research and the pilot plant stage in which the concept derived from fundamental data is demonstrated and investigated in bench scale equipment. It consist primarily of an examination of the chemistry and the thermodynamics. Work may range from batch operations in test tubes to semi-continuous or continuous operation in lab scale equipment. In new fields, a substantial amount of work is concentrated on methods for chemical analysis. It is unlikely that effects of recycle streams or trace elements can be determined.

The Pilot Plant is the tool which the chemical engineer uses to obtain a design basis for proceeding to commercialization. After assessment of the Process Development data and casting a conceptual design which is used as the basis for a preliminary economic evaluation, the chemical engineer determines what is needed to be known in order to: 1) provide a firm basis for a design and a refined economic analysis; 2) provide a basis for "trade-off" studies; 3) start to define erosion/corrosion problems; and, 4) to define control problems and technical risks.

The Pilot Plant is designed from these considerations, often after a call for more data from the laboratory. It is designed to operate over a wide range of conditions, whereas the bench scale work is usually initially concentrated on areas of highest yields and conversion, which areas often do not provide the optimum economic operating points. The Pilot Plant is heavily instrumented and is usually designed to allow easy changes of flow systems and reactor configurations.

An important consideration in the design of the Pilot Plant and the use of data from its operation is that relationships between and among various factors cannot be assumed to transfer precisely to a commercial system; e.g., catalyst size, surface to volume ratio, holding time and velocity, etc. Further, the scaling rules for these factors differ, particularly as they affect heat transfer, reaction, flow regime and corrosion - and further, the scaling rules are not even confirmed for some situations. The latter problem is especially severe in many systems involving the handling of solids.

Thus, the Pilot Plant is not a small scale commercial plant, but rather a tool used to determine how to design the commercial plant, to ascertain its potential economics, and to identify risk areas and their potential magnitude.

The Semi-Works plant in industry refers to a plant developed to provide an initial supply of product to the market quickly and at relatively low cost. If the market introduction is successful, a larger, fully equiped, commercial plant will be built; when it begins operating, the Semi-Works will be dismantled.

The term Demonstration Plant is not commonly used in industry. The first plant to go into commercial operation, if not built by the technology owner, is more likely to be called a Pioneer Plant. This terminology comes from "Pioneer Plant Agreements", in which the plant owner is given a reduced royalty/license fee and/or some equity in the technology in return for taking the risks inherent in the first scale-up from the largest previous pilot plant.

What seems to be wanted is a term such as "large pilot plant" or "sub-commercial unit", which describes a project intermediate in size between the first pilot plant and the projected commercial design. The purpose of an intermediate unit is to reduce the risk in going from the pilot to the commercial project by obtaining scaling data and correlations; the intermediate unit often is large enough to use off-the-shelf equipment of the same type of design as that to be used in the commercial project, and the intermediate unit uses the same type analytical and control equipment that is to be used in the commercial project. The intermediate size project or larger pilot plant is exemplified by the Texaco coal gasifiers at Ruhrkohle and TVA, and by the coal liquefaction projects at Ft. Lewis, Exxon, and Ashland.

The point to be noted is that the requirement for an intermediate project should be determined, in each case, by a cost/benefit/risk analysis. Many new/improved technologies have been introduced successfully without an intermediate step - and there are also many "monuments" to attempted commercial projects which failed in moving directly from pilot plant to commercial scale.

7. What kinds of technologies do you think may be in need of "semi-works" assistance?

The following technologies may benefit from assistance at the intermediate or semi-works level over the next 5 to 10 years.

- Process development and pilot plant work on improved technologies for direct coal liquefaction is proceeding; one or more of these may benefit from testing at the intermediate level.
- New in-situ processes for both coal gasification and shale oil recovery probably cannot go directly from the current small pilot projects to commercialization without large risks. Intermediate development will probably be necessary for these technologies to advance.
- There is a low temperature pyrolysis project which will not go ahead without an intermediate operation.
- Several innovative extraction type processes for tar sands may require intermediate scale operations to reduce risk.
- Development will be stimulated as the first commercial plants are designed and come into operation. This will lead directly to ideas for technology improvements leading to reduction in first costs and reduction in operating cost. Some of the ideas for technology improvement may require operational confirmation before application to a commercial design.

a. What indications do you have from industry that such facilities are needed?

For their own operations and for licensing out, most refiners, chemical operators, and utilities will require a succession of pilot operations of increasing size to reduce the risk. Fewer intermediate steps are acceptable only in an improvement situation where the relationship between pilots, intermediate, and commercial operations are already well established, such as with the introduction of a new catalyst in a known system, or when a substantial commercial opportunity makes the risk appear worth taking.

b. Please explain how such facilities could fit into the SFC's plans.

The Corporation currently has no authority to assist development units of any size.

Use of a commercial plant to provide development opportunities in a most cost effective manner is standard industry practice. Testing of a variety of feedstocks and of intermediate or full scale process improvements is done in parallel with the commercial operation in order to make use of existing feed and product systems, environmental control facilities, maintenance, engineering, etc., at relatively little added cost. In contracts providing for assistance to commercial projects, the Corporation has added clauses to provide for this type of development. These clauses require good faith negotiations between the plant owner and the technology developer.

c. If semi-works are not funded in the next several years what effect will it have on future technologies?

First, it seems apparent that industry will not proceed beyond the small pilot plant stage until the market offers incentives sufficient to justify the high cost of technology development. Federal incentives may allow some of these advanced technologies to be brought forward earlier.

If no intermediate projects are funded over the next two to three years, the technologies most likely to be affected are direct coal liquefaction and low temperature pyrolysis. With the tar sands extraction projects and some of the in-situ technologies, market condition and technical risk considerations may make it possible for industry sponsors to take the added risk of omitting the intermediate operation and move directly to commercial scale.

8. a. With regard to the outlay projections computed by the Corporation, and included in your testimony, please recompute these projections,

1) On a net present value basis, as you do with price per barrel calculations, and separately,

2) With an assumption of treasury debt financing costs for outlays.

8. b. Please recompute the price per barrel subsidies assuming treasury debt financing costs for outlays.

The requested computations are displayed on Attachments 1 and 2 using the current SFC and DOE median price projections, respectively. The projects included are those eleven with which the Corporation currently has contracts executed or letters of intent authorized.

These projections assume that the Treasury funds the Corporation net outlays by issuing Treasury bills on which interest must be paid (and funded). To calculate after-tax effect at the Treasury level, a marginal federal tax rate of 46% is used. The Corporation price guarantee receipts represent taxable income, and profit sharing payments to the Corporation are deductible for tax purposes; interest received by holders of Treasury bills also represents taxable income.

With respect of question 8(a)(1), the aggregate net present value of projected Corporation outlays ranges from $1.15 to $1.58 billion under the DOE and Corporation price scenarios, respectively, shown at the first line of the first column of each attachment. Including an assumption of Treasury debt financing for outlays, the next present value of aggregate and per barrel outlays are set forth in the last line of the first and second columns of the attachments as follows:

	Present Discounted Values ($1984) of Net After-Tax Treasury Outlays	
	Total ($MM)	Per Barrel
SFC Median Price Scenario	$1,452	$1.38
DOE NEPP-1983 Median Price	$1,125	$1.07

In performing the hypothetical Treasury funding calculations, we note that the after-tax financing charges shown on line 4 do not represent any new claim on real resources, but simply the cost of deferred financing of the real resource claims shown on line 3 - Treasury Net Outlays. Thus we believe the important focus should be on the discounted net present value of outlays, rather than projecting Treasury financing policy for 25 years. In effect, the OMB methodology for calculating present values takes into account this element by using a 10% real discount factor.

In sum, the present value of all net outlays required from the Corporation is $1.1 to $1.6 billion ($0.6 to $0.9 billion after Treasury tax effect but excluding Treasury financing costs) to induce the construction of eleven plants which will prove up significant technologies and resources and produce over 1 billion barrels of oil (10% of the entire North Slope) in the process.

attachments

Attachment 1

United States Synthetic Fuels Corporation
Effect of SFC Assistance on U.S. Treasury Net Outlays*
SFC Contracted & Committed Projects (June 22, 1984)
SFC Version 8 Median Scenario
($MM)

	PDV ($1984)	PDV/bbl ($1984	1984-85	1986-90	1991-95	1996-2000	2001-10	Total
1) SFC Net Outlays	$1,582	$1.50	$163	$2,189	$3,997	$(1,081)	$(5,050)	$ 218
2) Associated Tax Revenues			75	1,007	1,839	(497)	(2,323)	100
3) Treasury Net Outlays	$ 854	$ .81	88	1,182	2,158	(584)	(2,727)	118
4) After-tax Finance Charges			1	238	1,006	1,699	4,061	7,005
5) Treasury Total Outlays	$1,452	$1.38	$ 89	$1,420	$3,164	$ 1,115	$ 1,334	$7,123

* Numbers may not sum exactly due to rounding.

6/29/84
J.Harris/1585F

Attachment 2

United States Synthetic Fuels Corporation
Effect of SFC Assistance on U.S. Treasury Net Outlays*
SFC Contracted & Committed Projects (June 22, 1984)
DOE NEPP-1983 Median Energy Prices
($MM)

	PDV ($1984)	PDV/bbl ($1984	1984-85	1986-90	1991-95	1996-2000	2001-10	Total
1) SFC Net Outlays	$1,156	$1.10	$150	$2,084	$3,457	$(2,478)	$(9,137)	$(5,924)
2) Associated Tax Revenues			69	959	1,590	(1,140)	(4,203)	(2,725)
3) Treasury Net Outlays	$ 624	$ .59	81	1,125	1,867	(1,338)	(4,934)	(3,199)
4) After-tax Finance Charges			2	231	889	1,497	2,203	4,822
5) Treasury Total Outlays	$1,125	$1.07	$ 83	$1,356	$2,756	$ 159	$(2,731)	$ 1,623

* Numbers may not sum exactly due to rounding.

6/29/84
J.Harris/1585F

DON FUQUA (Fla.), Chairman

ROBERT A. ROE, N.J.
GEORGE E. BROWN, JR., CALIF.
JAMES H. SCHEUER, N.Y.
RICHARD L. OTTINGER, N.Y.
TOM HARKIN, IOWA
MARILYN LLOYD, TENN.
DOUG WALGREN, PA.
DAN GLICKMAN, KANS.
ALBERT GORE, JR., TENN.
ROBERT A. YOUNG, MO.
HAROLD L. VOLKMER, MO.
BILL NELSON, FLA.
STAN LUNDINE, N.Y.
RALPH M. HALL, TEX.
DAVE MC CURDY, OKLA.
MERVYN M. DYMALLY, CALIF.
PAUL SIMON, ILL.
NORMAN Y. MINETA, CALIF.
RICHARD J. DURBIN, ILL.
MICHAEL A. ANDREWS, TEX.
BUDDY MAC KAY, FLA.
TIM VALENTINE, N.C.
HARRY M. REID, NEV.
ROBERT G. TORRICELLI, N.J.
FREDERICK C. BOUCHER, VA.

U.S. HOUSE OF REPRESENTATIVES

COMMITTEE ON SCIENCE AND TECHNOLOGY

SUITE 2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, D.C. 20515
(202) 225-6371

LARRY WINN, JR., KANS.
MANUEL LUJAN, JR., N. MEX.
ROBERT S. WALKER, PA.
WILLIAM CARNEY, N.Y.
F. JAMES SENSENBRENNER, JR., WIS.
JUDD GREGG, N.H.
RAYMOND J. MC GRATH, N.Y.
JOE SKEEN, N. MEX.
CLAUDINE SCHNEIDER, R.I.
BILL LOWERY, CALIF.
ROD CHANDLER, WASH.
HERBERT H. BATEMAN, VA.
SHERWOOD L. BOEHLERT, N.Y.
ALFRED A. MC CANDLESS, CALIF.
TOM LEWIS, FLA.

HAROLD P. HANSON
Executive Director
ROBERT C. KETCHAM
General Counsel
DAVID S. JEFFERY
Minority Staff Director

June 19, 1984

Hon. William A. Vaughan
Asst. Secretary for Fossil Energy
U.S. Department of Energy
Washington, D.C. 20585

Dear ~~Mr. Vaughan~~ Bill:

Thank you for your testimony before the Subcommittee on Energy Development and Applications on June 7, 1984. Attached are some additional questions that Members of the Subcommittee would like you to answer, in order to supplement the record of the hearing on this topic.

I would appreciate your responses to the hearing questions by July 3, 1984. If you have any questions regarding this request, please contact Mr. Robert S. Kripowicz, Subcommittee Staff Director, at (202) 225-4494.

Sincerely,

DON FUQUA
Chairman

DF:Kcw
attachment

Department of Energy
Washington, D.C. 20585

July 6, 1984

Honorable Don Fuqua
Chairman, Subcommittee on Energy
Development and Applications
Committee on Science and Technology
House of Representatives
Washington, D. C. 20515

Dear Mr. Fuqua:

Following the June 7, 1984, hearing on cost-shared energy technology facilities and projects, held by the Subcommittee on Energy Development and Applications, you sent William A. Vaughan some questions. Enclosed are our responses to those questions.

We are also sending Christine Wegman of the Subcommittee staff a copy of the responses under separate cover.

If you have any questions, please do not hesitate to contact Tom Pretorius or Diana Diamond of my staff on 252-4277. They will be happy to assist you.

Sincerely,

Thomas A. Pretorius
for Robert G. Rabben
Assistant General Counsel
for Legislation

Enclosure

HS&T
6/7/84 Hearing
D. Fuqua

1Q. In considering various energy projects in the past, there has been much talk about the appropriate cost-sharing arrangements between the Federal Government and the private sector.

Do you believe that a 50/50 cost-sharing arrangement at the pilot project stage is too high? If so, why?

A. Relative to recent cost-sharing experiences, we have found that for basic and applied research projects, where actual cost-sharing (as contrasted to other forms of leveraging federal funding), a range of 5-15 percent cost-sharing has generally been achieved. For proof-of-concept projects the variability has been greater, reflecting the differences from case to case in the overall private investment situation and related activities that surround the specific individual project being funded. A range of 10-35 percent has generally been achieved in these situations. For those technologies requiring larger, integrated scale-up to achieve proof-of-concept, the Department seeks 50/50 cost sharing, but the actual percentage is negotiated on a case-by-case basis.

The Administration has not requested funds for projects beyond proof-of-concept scale. If funds should be appropriated for such activity, we would expect the percent of cost-sharing sought from industry to be 50 percent or more, again with the actual percentage to be determined on a case-by-case basis. This is based on past cost-sharing experience and the realization that as a technology moves toward more advanced stages of R&D, the ability to predict commercial potential improves, thus lowering the risk to private sector investors.

2Q.

a. To address the broad range of energy technology, how would DOE request pilot plant proposals if adequate funding were available to assure meaningful response?

b. What participation would you anticipate from the Synthetic Fuels Corporation in planning the scope and content of a proposal solicitation and implementation?

A. DOE has not requested funds for pilot plant activities. If Congress appropriates funds to conduct activities, private sector participation in a DOE pilot plant program would be sought by formal solicitation.

In large proposals of this kind, traditionally DOE issues a solicitation and simultaneously advertises in the Commerce Business Daily. The private sector then is invited to submit proposals covering such items as resource base selection, plant location, process technology, data rights, commercialization potential, period of operation, product utilization, true risk and cost sharing by the private sector, anticipated technology advancements, improved environment, health and safety control and understanding, participation by or support from state and other interests. If we were to implement pilot plant proposals, DOE staff would consult with SFC staff and consider SFC interests prior to formal issuance of Notice of Program Interest.

3Q. In the event that DOE entered into a contract with an industrial entity to design, construct and operate a pilot plant, what position do you expect that DOE would take relative to industry's background knowledge and to pilot plant project discoveries?

A. We feel in all energy projects cost sharing allowances and relationship to industry's background knowledge and to pilot plant project discoveries (i.e., patents) should be decided on a case-by-case basis. Credits against cost sharing would be limited to the after tax value of the actual cost of true Research and Development in the area of DOE's program interest.

In the past, ERDA and DOE programs have permitted allowances against cost sharing for such as use of patents and background knowledge, use of existing facilities, loss of revenue, allowances for use of personnel, and use of proprietary information. Such allowances against shared costs have had the general effect of less than desirable up front private sector participation. This approach had the net effect of the government being the source of a major part of project funds.

DOE will seek to minimize allowances for less-than-real money contributions so as to provide early, up front, participation by the private sector and to reduce federal contributions.

Inventions made and reduced to practice during cost shared pilot plant programs, where the private sector participates in cost sharing in real terms and has agreed to make available to others, at reasonable cost, prior data and data developed during the pilot plant program should be shared between the Goverment and the private sector's participants on the basis of cost sharing.

4Q. In the past, DOE has been faulted for cost overruns, project delays and improper management in the construction of various energy pilot projects. What improvements do you believe could be made at DOE in order to improve such construction programs?

A. Cost overruns and project delays, in many cases, have occurred because the technology is the first of its kind and not because of lax or improper management. The first estimates sent to Congress are for budgeting purposes and are prepared well in advance of any final design efforts. Costs and schedules should be expected to change as the design progresses.

In addition to the program staff, DOE has an independent cost estimating staff to develop estimates and an independent engineering staff to review significant projects for estimated costs and resource requirements. DOE has also implemented cost and schedule control system criteria to ensure that revisions to a project must go through a rigorous examination before approval. This should enhance our ability to keep costs down.

By requiring that industrial participants contribute a significant percentage of the total costs of a project, the Department can ensure that the partner has the incentive to maintain costs and schedules to the greatest extent possible. We believe the private partner should share a substantial portion of the costs from the beginning of the project, and an early involvement should improve the process of constructing these facilities.

DON FUQUA (Fla.), Chairman

ROBERT A. ROE, N.J.
GEORGE E. BROWN, JR., CALIF.
JAMES H. SCHEUER, N.Y.
RICHARD L. OTTINGER, N.Y.
TOM HARKIN, IOWA
MARILYN LLOYD, TENN.
DOUG WALGREN, PA.
DAN GLICKMAN, KANS.
ALBERT GORE, JR., TENN.
ROBERT A. YOUNG, MO.
HAROLD L. VOLKMER, MO.
BILL NELSON, FLA.
STAN LUNDINE, N.Y.
RALPH M. HALL, TEX.
DAVE MC CURDY, OKLA.
MERVYN M. DYMALLY, CALIF.
PAUL SIMON, ILL.
NORMAN Y. MINETA, CALIF.
RICHARD J. DURBIN, ILL.
MICHAEL A. ANDREWS, TEX.
BUDDY MAC KAY, FLA.
TIM VALENTINE, N.C.
HARRY M. REID, NEV.
ROBERT G. TORRICELLI, N.J.
FREDERICK C. BOUCHER, VA.

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
SUITE 2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, D.C. 20515
(202) 225-6371

LARRY WINN, JR., KANS.
MANUEL LUJAN, JR., N. MEX.
ROBERT S. WALKER, PA.
WILLIAM CARNEY, N.Y.
F. JAMES SENSENBRENNER, JR., WIS.
JUDD GREGG, N.H.
RAYMOND J. MC GRATH, N.Y.
JOE SKEEN, N. MEX.
CLAUDINE SCHNEIDER, R.I.
BILL LOWERY, CALIF.
ROD CHANDLER, WASH.
HERBERT H. BATEMAN, VA.
SHERWOOD L. BOEHLERT, N.Y.
ALFRED A. MC CANDLESS, CALIF.
TOM LEWIS, FLA.

HAROLD P. HANSON
Executive Director
ROBERT C. KETCHAM
General Counsel
DAVID S. JEFFERY
Minority Staff Director

June 19, 1984

Dwain F. Spencer, Vice President
Electric Power Research Institute
P. O. Box 10412
Palo Alto, California 94303

Dear Mr. Spencer:

Thank you for your testimony before the Subcommittee on Energy Development and Applications on June 7, 1984. Attached are some additional questions that Members of the Subcommittee would like you to answer, in order to supplement the record of the hearing on this topic.

I would appreciate your responses to the hearing questions by July 3, 1984. If you have any questions regarding this request, please contact Mr. Robert S. Kripowicz, Subcommittee Staff Director, at (202) 225-4494.

Sincerely,

DON FUQUA
Chairman

DF:Kcw
attachment

EPRI
Electric Power
Research Institute

June 25, 1984

Honorable Don Fuqua, Chairman
Committee on Science and Technology
U.S. House of Representatives
Suite 2321
Rayburn House Office Building
Washington, DC 20515

Dear Congressman Fuqua:

The purpose of this letter is to respond to the questions which you submitted to me on 19 June 1984 to supplement my testimony before your Subcommittee on Energy Development and Application on 7 June 1984. My responses are attached and hope that you find them beneficial in your important considerations.

Let me also mention that we completed our ten day acceptance test at Cool Water last Saturday, June 23 (within seven weeks of initial start-up) and have met our design performance requirements for power output, environmental control, and operability of the unit. We, of course, are extremely pleased with the early success of the plant and hope that you will be able to join us for the Cool Water dedication ceremony on 17 October 1984 at the site. I remain convinced that the only way to confidently evaluate a new technology is operation of the system at full commercial scale. Although we do not yet know how reliable/available the Cool Water plant and process will be, we must obtain extended operating data at this scale to assure utilities that their investment risks are justified for future commercial units.

Our price guarantee with the Synthetic Fuels Corporation now becomes operative, and, I want to again thank you for both your support of the SFC and for the specific interest which you have shown in the Cool Water Project. We believe that integrated coal gasification combined cycle systems can enhance our nation's ability to utilize a broad range of domestic, high sulphur coals in an economically competitive, environmentally superior fashion. We, at EPRI, are proud to have played a role in bringing this important technology to the electric utility industry of our country.

If I can assist you in any additional way, please call upon me.

Sincerely,

D. F. Spencer
Vice President
Advanced Power Systems

RECEIVED
1984
COMMITTEE ON SCIENCE
AND TECHNOLOGY

DFS/bc
Attachment

3412 Hillview Avenue, Post Office Box 10412, Palo Alto, CA 94303 Telephone (415) 855-2000
Washington Office: 1800 Massachusetts Ave., NW, Suite 700, Washington, DC 20036 (202) 872-9222

ATTACHMENT

Response to Questions From
Congressman Fuqua

(Supplement to 7 June 1984 Testimony to
Subcommittee on Energy Development and Application)

1) On page 1 of your statement you say that "...the utility industry, in general, will require operation of full scale facilities for any new technology...before they will make significant commercial investments in new technologies."

a) In your view, will this occur without federal assistance?

As I stated in my testimony, the conduct of large-scale demonstration projects in the multi tens to hundreds of megawatts, will most likely require federal government assistance, in the form of capital and/or an operating cost subsidy. In the four demonstration projects in which EPRI is presently participating, namely Cool Water, Heber, the 4.8MW Fuel Cell, and the 160MW AFBC Demonstration, all have required significant federal support. Although the private utility sector would prefer to fund technology developments/demonstration themselves, seldom does this occur. I envision future projects of these types to continue to require substantial federal support.

b) How do you propose such projects would best be implemented? That is, by what mechanism should projects be funded and by what mechanisms should federal assistance be requested?

In the past, EPRI, DOE, and other industrial partners have worked very effectively by utilizing co-operative agreements whereby the private sector provides at least 50 percent of the capital and the government the other 50 percent. In this way, the primary technical management is vested in the private sector, and I believe this is a crucial requirement for successful demonstration of a new technology. Federal government procurement and bureaucratic requirement can easily result in schedule slippages and overruns if the federal government "runs the project". I believe private sector management is the most cost effective approach, with appropriate levels of management review and approval from all participating parties.

I believe that the best way to initiate such projects is by private sector groups submitting an unsolicited proposal to the government for consideration. In this way, the federal government can measure the level of the private sector financial commitment and assess the technical state of readiness of the technology before public funds are expended. In general, this also will help "filter out" the poorly conceived projects since they will not have a clear private sector endorsement or support.

If the federal government perceives a need for technological demonstration in an area not being proposed by industry, it should first ask itself, "Why isn't industry interested?" Is the technology uneconomic, technically not ready for demonstration, etc. If after proper consideration of these questions, the government still decides to proceed, then a broad program solicitation should be written. In my judgment, the government should not attempt to choose the specific process technology such as was done with the SRC-1 and SRC-2 demonstration projects without some type of broad informal solicitation to industry at large.

As I stated in my testimony, operating subsidies, such as that being provided by the SFC to Cool Water, may be equally as important as a capital contribution. In this case, the federal government accepts even less risk and only has an "obligation to pay" if the plant is designed and constructed and an "acceptance test" is successfully passed. In this case, I believe that the SFC, or some similar entity, is a more appropriate funding mechanism than DOE. The "once removed" position of the SFC from normal federal procurement practices is the primary benefit of dealing with such an entity.

In both of the previously discussed funding roles by the government, there should be some mechanism for income from the demonstration plant or future commercial units to be returned to the government, i.e., the taxpayers. Royalty sharing or some equivalent approach should be an integral part of the "business deal".

Finally, some companies may prefer additional tax advantages, such as allowing capital costs for demonstration or power plants to be expensed in the year incurred against other taxable profits. This minimizes federal government intervention and provides the maximum flexibility to the process as technology develops. In this case, the public still bears the burden of assisting the demonstration of the new technology, but only the technology developer benefits from commercial sales. Therefore, the government must decide on the true benefit to the nation of a tax incentive approach. I believe such an approach can be beneficial to the nation, but also badly misused as for example has occurred in the deployment of hundreds of poor quality wind turbines and solar collectors.

In summary, I believe the federal government should maintain a flexible position for technology demonstration support, but relying primarily on the private sector to identify and manage the demonstration of appropriate processes or technologies.

c) If federal assistance is required, what criteria should be used by the government to judge what facilities should be assisted?

This is an extremely difficult question to answer without extensive consideration; however I will offer a few key considerations which I utilize in attempting to make such judgments in behalf of EPRI.

1) Does the process/technology show promise of being economically competitive with present commercial systems within the next ten years?

2) Is there a well defined process/technology development history of operation at various scales (bench scale, process development unit, large pilot plant) that provides some confidence that a demonstration project is likely to be successful? What are the key remaining technical risks? Scale up? New materials? etc?

3) Do the proposers of the demonstration have experience in defining, conducting, and managing projects of this magnitude (perhaps $100 million to $500 million). If not, why do they think that they'll be successful in this venture? Is there a clearly committed "host utility"?

4) Are the technical performance objectives realistic?

5) How firm are the proposed cost and schedule? Has a preliminary engineering evaluation and process design been conducted? Have all elements of the plant, including off-sites, been properly considered? What are the critical path items and who are the likely vendors for these units?

6) Does the proposal address the importance of test and operations planning? Does the proposer have operating experience within his team on processes/technologies of comparable complexity?

7) In the government's opinion, could the project be financed totally by the private sector? Is the proposer requesting the minimal financial assistance necessary to make the project "go"?

d) What role should EPRI or other private sector entities have in project evaluation and priority setting? What role should DOE have?

If the demonstration project involves technology of direct benefit to the electric utility industry, EPRI should, as a minimum, be an equity partner in the project. In most cases, I would expect that EPRI, in cooperation with DOE and the other private sector participants, would have developed a meaningful technical, economic, and environmental basis for the value of this technology demonstration and be capable of at least clearly relating to the evaluation criteria enumerated above.

I tend to think of DOE (or the SFC) as primarily a federal funding partner in such ventures, rather than the primary stimulant for the program as I have stated above. Of course, DOE should carefully make its own assessment of the potential value of the demonstration to the nation, before agreeing to being a partner.

2) Would legislation establishing an overall demonstration scale activity in DOE be helpful to the utility industry?

Yes, I believe that DOE support for demonstration, if primarily managed by industry and with at least 50 percent industry cost sharing, would be very beneficial to the electric utility industry and the nation.

a) If so, what general requirements should be included?

1) There should be a clearly defined, committed "host utility" for the project. This commitment must include the top management of the utility as well as the technical managers.

2) Cofunding of at least 50 percent should be required from the private sector.

3) Operating periods for the demonstration facility should be no less than two years, and preferably five years.

4) Adequate planning and funding for operations should be included in funding requests.

5) Process/technology developer proprietary rights should be protected.

6) The government should have a mechanism to recover its investment in the technology.

7) The government should vest project management and control in the private sector.

b) Should demonstration activity be limited to fossil fuel projects?

No, I believe that demonstration project legislation should at least include fossil and renewable energy technologies, and perhaps advanced modular nuclear fission systems. However, I do believe that the primary emphasis in the next few years should be focused on coal conversion and utilization technologies and shale. Lesser priority should be given to renewables and advanced nuclear fission systems. If a compromise were necessary, support for only fossil (coal and shale) would still be a significant contribution to bringing new technologies to the full commercial scale of operation.

We, at EPRI, stand ready to work effectively with the federal government to make such a demonstration program effort meaningful to the electric utility industry and the nation.

DON FUQUA (Fla.), Chairman

ROBERT A. ROE, N.J.
GEORGE E. BROWN, JR., CALIF.
JAMES H. SCHEUER, N.Y.
RICHARD L. OTTINGER, N.Y.
TOM HARKIN, IOWA
MARILYN LLOYD, TENN.
DOUG WALGREN, PA.
DAN GLICKMAN, KANS.
ALBERT GORE, JR., TENN.
ROBERT A. YOUNG, MO.
HAROLD L. VOLKMER, MO.
BILL NELSON, FLA.
STAN LUNDINE, N.Y.
RALPH M. HALL, TEX.
DAVE MC CURDY, OKLA.
MERVYN M. DYMALLY, CALIF.
PAUL SIMON, ILL.
NORMAN Y. MINETA, CALIF.
RICHARD J. DURBIN, ILL.
MICHAEL A. ANDREWS, TEX.
BUDDY MAC KAY, FLA.
TIM VALENTINE, N.C.
HARRY M. REID, NEV.
ROBERT G. TORRICELLI, N.J.
FREDERICK C. BOUCHER, VA.

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
SUITE 2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, D.C. 20515
(202) 225-6371

LARRY WINN, JR., KANS.
MANUEL LUJAN, JR., N. MEX.
ROBERT S. WALKER, PA.
WILLIAM CARNEY, N.Y.
F. JAMES SENSENBRENNER, JR., WIS.
JUDD GREGG, N.H.
RAYMOND J. MC GRATH, N.Y.
JOE SKEEN, N. MEX.
CLAUDINE SCHNEIDER, R.I.
BILL LOWERY, CALIF.
ROD CHANDLER, WASH.
HERBERT H. BATEMAN, VA.
SHERWOOD L. BOEHLERT, N.Y.
ALFRED A. MC CANDLESS, CALIF.
TOM LEWIS, FLA.

HAROLD P. HANSON
Executive Director
ROBERT C. KETCHAM
General Counsel
DAVID S. JEFFERY
Minority Staff Director

June 19, 1984

David O. Webb, Senior Vice President
Gas Research Institute
1019 19th Street, N.W., Suite 910
Washington, D.C. 20036

Dear Dave:

Thank you for your testimony before the Subcommittee on Energy Development and Applications on June 7, 1984. Attached are some additional questions that Members of the Subcommittee would like you to answer, in order to supplement the record of the hearing on this topic.

I would appreciate your responses to the hearing questions by July 3, 1984. If you have any questions regarding this request, please contact Mr. Robert S. Kripowicz, Subcommittee Staff Director, at (202) 225-4494.

Sincerely,

Don

DON FUQUA
Chairman

DF:Kcw
attachment

RESPONSE TO QUESTIONS FROM HEARING OF JUNE 7, 1984
BEFORE THE SCIENCE AND TECHNOLOGY COMMITTEE
SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS
GAS RESEARCH INSTITUTE

1. The Department of Energy states that it is its policy not to fund pilot or semiworks facilities.

    a. In your opinion will industry attempt to fund facilities of this size on its own?

    No, not the regulated segments of industry. With the current high interest rates, stable or declining world oil prices, and a surplus of natural gas and coal in the domestic market, industry will continue to fund only those near- and mid-term projects when there is the probability of an early, high payoff and full cost recovery through regulatory proceedings.

    b. Do you have sufficient funds to help individual companies or consortia build such facilities?

    Only with federal support of 50 percent of the cost and with help from industrial partners. When the Administration announced they would be undertaking only high-risk, long-term R&D, GRI readjusted its program to undertake research and development of near- and mid-term projects. In 1984 GRI's program funding is approximately 65 percent dedicated to these near- and mid-term projects. In order to move to funding semiworks, there would have to be a strong federal commitment to justify expanding our role to semiworks on a large scale.

    c. Do private companies have such funds?

    Speaking for fossil energy facilities which are natural gas related, the regulated industry does not have the funds nor the inclination to undertake pilot or semiworks plants. In a study issued by DOE's Energy Research Advisory Board it was recognized that, "A little over half our primary energy finds its way to consumers through the electric and gas utilities, and the utilities are regulated, price-controlled industries, selling their products not at free market prices, but at controlled prices well below replacement cost . . . Both these regulated industries have weak incentives to spend on R&D. If successful, the benefits go to ratepayers; if unsuccessful, the expenditure may be disallowed as 'imprudent'." Without an assured major federal role so the regulated gas companies can seek regulatory preapproval for their investments in these types of facilities, the gas companies will not build.

2. You suggest, on page 7 of your testimony, that " . . . the Administration consider developing and demonstrating advanced processes at existing commercial synthetic fuels plants, where most of the necessary components and required services are already in place.

    a. Have you discussed the concept with the Great Plains partners?

    GRI has had preliminary discussions with Great Plains, and they have expressed an interest provided we meet certain safeguards. We have also had some very preliminary discussions with DOE program level personnel.

b. What problems would such a request cause a commercial facility?

No major problems have been identified but it must be understood that any such undertaking must be carefully coordinated to avoid interruption of the daily operations of the existing plant, conflicts between scheduling for the test facility and the normal operations of the plant, and safety of the operation. In addition, consideration must be given to land availability, utilities, support services, facility limitations, and legal, administrative, or regulatory constraints. It must be clearly understood that the commercial facility has preemptive rights to avoid the possibility of the test facility's disrupting the commercial plant operations.

3. On page 1 of your testimony you state that, "The demonstration of emerging fossil energy and conservation technologies should be a major element of the research program of the Federal Government." Yet in the rest of your testimony you deal exclusively with fossil energy technologies. Do you have any recommendations for conservation technology demonstrations?

My testimony focused the discussion on the need for advanced fossil energy technology demonstrations since the bills that have been introduced and are pending before the Committee propose programs and funding for coal conversion demonstration facilities. To deal with one subject in detail within the ten minutes alloted for oral testimony, I focused only on fossil energy technologies. However, I would like to state it is equally important for the federal government to take the lead in working with industry to demonstrate advanced technologies at the pilot or semiworks scale. In the area of conservation demonstrations, the gas industry recommends cofunded programs with DOE in:

- Gas fired heat pumps (residential and commercial)
- Onsite fuel cells (200 to 400 kW size)
- Industrial cogeneration
- Industrial burners

Can you tell us for conservation technologies what support might be helpful?

I recommend DOE develop a firm and consistent policy to undertake and support a partnership with industry in the demonstration of advanced conservation technologies at the semiworks scale. Congressional authorization for full project funding once Congress has reviewed and approved the proposed demonstrations would also be extremely helpful. Currently, there is too much uncertainty within the Department regarding policy and too many inconsistencies in budget requests for specific projects. The regulated industry cannot plan in such an environment.

DON FUQUA (Fla.), Chairman

ROBERT A. ROE, N.J.
GEORGE E. BROWN, JR., CALIF.
JAMES H. SCHEUER, N.Y.
RICHARD L. OTTINGER, N.Y.
TOM HARKIN, IOWA
MARILYN LLOYD, TENN.
DOUG WALGREN, PA.
DAN GLICKMAN, KANS.
ALBERT GORE, JR., TENN.
ROBERT A. YOUNG, MO.
HAROLD L. VOLKMER, MO.
BILL NELSON, FLA.
STAN LUNDINE, N.Y.
RALPH M. HALL, TEX.
DAVE MC CURDY, OKLA.
MERVYN M. DYMALLY, CALIF.
PAUL SIMON, ILL.
NORMAN Y. MINETA, CALIF.
RICHARD J. DURBIN, ILL.
MICHAEL A. ANDREWS, TEX.
BUDDY MAC KAY, FLA.
TIM VALENTINE, N.C.
HARRY M. REID, NEV.
ROBERT G. TORRICELLI, N.J.
FREDERICK C. BOUCHER, VA.

U.S. HOUSE OF REPRESENTATIVES

COMMITTEE ON SCIENCE AND TECHNOLOGY

SUITE 2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, D.C. 20515
(202) 225-6371

LARRY WINN, JR., KANS.
MANUEL LUJAN, JR., N. MEX.
ROBERT S. WALKER, PA.
WILLIAM CARNEY, N.Y.
F. JAMES SENSENBRENNER, JR., WIS.
JUDD GREGG, N.H.
RAYMOND J. MC GRATH, N.Y.
JOE SKEEN, N. MEX.
CLAUDINE SCHNEIDER, R.I.
BILL LOWERY, CALIF.
ROD CHANDLER, WASH.
HERBERT H. BATEMAN, VA.
SHERWOOD L. BOEHLERT, N.Y.
ALFRED A. MC CANDLESS, CALIF.
TOM LEWIS, FLA.

HAROLD P. HANSON
Executive Director
ROBERT C. KETCHAM
General Counsel
DAVID S. JEFFERY
Minority Staff Director

June 19, 1984

Dr. Maxine Savitz
5019 Lowell Street, N.W.
Washington, D.C. 20016

Dear ~~Dr. Savitz~~ Maxine:

Thank you for your testimony before the Subcommittee on Energy Development and Applications on June 13, 1984. Attached are some additional questions that Members of the Subcommittee would like you to answer, in order to supplement the record of the hearing on this topic.

I would appreciate your responses to the hearing questions by July 3, 1984. If you have any questions regarding this request, please contact Mr. Robert S. Kripowicz, Subcommittee Staff Director, at (202) 225-4494.

Sincerely,

DON FUQUA
Chairman

DF:Kcw
attachment

6/13

Questions for Dr. Maxine Savitz

1. We have heard a lot about the successful cost-shared demonstration projects that were funded by the DOE Office of Industrial Programs.

   a. Should that program serve as a model for such cost-sharing?

   b. Is that program continuing to fund demonstrations at all?

Answer:

1.a. Due to the experience of the industrial program in negotiating cost-sharing and innovative contractural arrangements, such as buy-back provisions, it could be a model as long as it was on a case-by-case basis.

1. b. The program is not continuing to fund demonstrations in the sense of multiple, commercial sized systems. It continues to support technology "proof-of-concept" field testing to the point where it has been proved that the technology works. The degree of proof depends upon the technology and industry involved. The FY1985 budget request is the first one in three years to contain funds for these types of programs. Most of the projects are continuations of those initiated before 1981, but have moved to the demonstration phase in their logical development. There are a few new ones such as the metal strip casting, but that was accelerated by Congress. New ones initiated by the program include St. Regis paper control study, forest residue chip drying, and the next generation of high temperature recuperators.

2. Would it be possible to use federal facilities to test and demonstrate new energy efficient techniques for buildings?

How might such a program be structured?

Answer:

2. The federal facilities could be useful and should be used for the demonstration of technical readiness and reliability, but not necessarily economic readiness. Since occupants of federal buildings are not much different than tenants in the private sector, institutional demonstrations to motivate tenants could be tried in federal facilities. Building technologies lend themselves the most easily to demonstrations, but there should also be testing and demonstrations of innovative design and construction techniques. Since many federal facilities are exempt from local building codes, new design techniques could be demonstrated and documented and then incorporated into building codes. Commercial federal buildings--offices, hospitals, schools--are similar to those in the private sector. Residential buildings predominately owned by DOD are less representative, but there are some single family and multi-family residences on bases.

Funding of these programs, as for non-federal demonstrations, should include sufficient dollars for the installation, monitoring, service, and comprehensive data collection. The number of units to be demonstrated should depend on the technical readiness. Funding should be cost-shared between DOE and GSA or DOD in the same way that there is cost-sharing with the private sector. This will get the agency involved and enhance the likelihood that the agency will purchase the technology once it is demonstrated. Adoption of all new energy efficient technologies should be encouraged by listing them in the supply catalogues not just those that are demonstrated. It would be instructive to have the major procurement agencies report to DOE and Congress what they are doing in this area. To give visibility to the use of federal facilities for demonstration of technologies, it would be useful to form a subcommittee of the "656" Committee to be responsible for identifying technologies and the appropriate agencies. The Under Secretary at DOE chairs this committee. Once the technology and agency have been agreed upon, the demonstration should be managed by the appropriate conservation program office and not this committee, but it should monitor the involvement.

DON FUQUA (Fla.), Chairman

ROBERT A. ROE, N.J.
GEORGE E. BROWN, JR., CALIF.
JAMES H. SCHEUER, N.Y.
RICHARD L. OTTINGER, N.Y.
TOM HARKIN, IOWA
MARILYN LLOYD, TENN.
DOUG WALGREN, PA.
DAN GLICKMAN, KANS.
ALBERT GORE, JR., TENN.
ROBERT A. YOUNG, MO.
HAROLD L. VOLKMER, MO.
BILL NELSON, FLA.
STAN LUNDINE, N.Y.
RALPH M. HALL, TEX.
DAVE MC CURDY, OKLA.
MERVYN M. DYMALLY, CALIF.
PAUL SIMON, ILL.
NORMAN Y. MINETA, CALIF.
RICHARD J. DURBIN, ILL.
MICHAEL A. ANDREWS, TEX.
BUDDY MAC KAY, FLA.
TIM VALENTINE, N.C.
HARRY M. REID, NEV.
ROBERT G. TORRICELLI, N.J.
FREDERICK C. BOUCHER, VA.

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
SUITE 2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, D.C. 20515
(202) 225-6371

LARRY WINN, JR., KANS.
MANUEL LUJAN, JR., N. MEX.
ROBERT S. WALKER, PA.
WILLIAM CARNEY, N.Y.
F. JAMES SENSENBRENNER, JR., WIS.
JUDD GREGG, N.H.
RAYMOND J. MC GRATH, N.Y.
JOE SKEEN, N. MEX.
CLAUDINE SCHNEIDER, R.I.
BILL LOWERY, CALIF.
ROD CHANDLER, WASH.
HERBERT H. BATEMAN, VA.
SHERWOOD L. BOEHLERT, N.Y.
ALFRED A. MC CANDLESS, CALIF.
TOM LEWIS, FLA.

HAROLD P. HANSON
Executive Director
ROBERT C. KETCHAM
General Counsel
DAVID S. JEFFERY
Minority Staff Director

June 19, 1984

Ian Straughan, Director of Research
Southern California Edison
P. O. Box 800
Rosemead, California 91770

Dear Dr. Straughan:

Thank you for your testimony before the Subcommittee on Energy Development and Applications on June 13, 1984. Attached are some additional questions that Members of the Subcommittee would like you to answer, in order to supplement the record of the hearing on this topic.

I would appreciate your responses to the hearing questions by July 3, 1984. If you have any questions regarding this request, please contact Mr. Robert S. Kripowicz, Subcommittee Staff Director, at (202) 225-4494.

Sincerely,

Don Fuqua

DON FUQUA
Chairman

DF:Kcw
attachment

6/13

EDA

Southern California Edison Company

SCE

P. O. BOX 800
2244 WALNUT GROVE AVENUE
ROSEMEAD, CALIFORNIA 91770

IAN R. STRAUGHAN, Ph.D.
DIRECTOR OF RESEARCH & DEVELOPMENT

TELEPHONE
(818) 572-1097

July 9, 1984

RECEIVED
JUL 16 1984
COMMITTEE ON SCIENCE
AND TECHNOLOGY

The Honorable Don Fuqua
Chairman
Committee on Science and Technology
U.S. House of Representatives
Suite 2321, Rayburn House Office Building
Washington, DC 20515

Dear Mr. Fuqua:

Thank you for the opportunity to clarify some of the points made in my testimony of June 13, 1984 before your Committee:

Question 1: Why can't the private sector supply the needed funds for development and demonstration of renewable energy technologies on its own, without federal support?

What kinds of problems have you experienced in efforts to obtain private financing for such projects?

Response: The prime "end use customers" of renewable energy technology are the utilities. When structuring a demonstration project of sufficient size to prove commerciality, the project must be regarded as utility property because it is too large to qualify under PURPA for treatment as non utility property. The project is, therefore, restricted in rate of return on investment to that allowed by the relevant state utilities commission. Such rates of return are determined for minimal risk associated with utilities normal capital investment. An R&D demonstration, on the other hand, is an extremely risky investment even when proof of concept may have been established by federal R&D programs. Investors, therefore, expect a much higher rate of return than is allowed on utility property. As a specific example, SCE working with McDonald Douglas Corporation determined that the optimal size for a commercial demonstration of Solar Central Receiver technology would be in the order of 100 MWe. Financing of this project could not be obtained because the capital investment was too large and the expected rate of return too low to attract investors. Reduction in the size of the project would result in operation and maintenance costs that could be met by revenues. Therefore, either a commercial prototype plant or a scaled down demonstration would require federal support.

Question 2: On page 4 of your testimony you say that a 20% cost-share is a generally accepted investment by industry in Engineering Development.

a. What is the basis for this figure?

b. Is "Engineering Development" equivalent to demonstration?

Response: My understanding is that in federally supported R&D projects, a 20% cost-sharing by the private sector entitles the private sector to rights, such as licenses, to the results.

Engineering development is a component of the total research development and demonstration process. It was specifically mentioned in this regard because it is the component that usually results in tangible products that can be marketed.

Sincerely,

IRS:han

APPENDIX II

Additional Statements for the Record

TOM CORCORAN
14th District, Illinois

Energy and Commerce
Committee
Subcommittee on Fossil and
Synthetic Fuels

Post Office and Civil
Service Committee
Subcommittee on Postal Operations
and Services

Commission on Congressional
Mailing Standards

Congress of the United States
House of Representatives
Washington, D.C. 20515

Washington Office:
2447 Rayburn House Office Building
Washington, D.C. 20515
(202) 225-2976

Illinois Offices:
115 Campbell Street
Geneva, Illinois 60134
(312) 232-0944

100 West Lafayette Street
Ottawa, Illinois 61350
(815) 434-0680

Illinois Toll-Free Action Line
(800) 942-0837

June 28, 1984

The Honorable Don Fuqua
Chairman, Subcommittee on
Energy Development and Applications
Committee on Science and Technology
House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

I would like to request that the enclosed June 13 letter from Central Illinois Light Company be included in the record of your subcommittee's June 7 hearing relative to coal technology.

While your June 7 hearing did not specifically address H.R. 5593, the subject of CILCO's June 13 letter, I believe that CILCO's comments would be useful as you consider coal technology and utilization. I joined Congresswomen Lloyd and others in introducing H.R. 5593, the "Clean Coal Production and Utilization Technology Demonstration Act," on May 3.

I believe that developing a record on this issue which includes the comments of the utility industry is important. As you can see from CILCO's letter, they are generally supportive of the approach of H.R. 5593, although they have several constructive suggestions to improve the bill. CILCO is particularly concerned about promoting the use of high-sulfur Illinois coal.

Thank you for your consideration of this request. Particularly as the senior Republican member of the Energy and Commerce Committee's Subcommittee on Fossil and Synthetic Fuels, I look forward to working with you on H.R. 5593 and related legislation.

Sincerely,

Tom Corcoran
Representative in Congress

Enc.
cc: Hon. Larry Winn, Jr.
Hon. F. James Sensenbrenner, Jr.
Hon. Marilyn Lloyd

DATE ANS: 6/28/8 DOC #: 19653
AIDE: Al REC #: 2079
CATS: 13590
PARA: h/t
DATE IN:
FILL INS: JUN 19 1984
FAMILIAR: Dick
DAN'S NOTES: Al

CILCO
Central Illinois Light Company
300 LIBERTY ST / PEORIA IL 61602

June 13, 1984

The Honorable Tom Corcoran
2447 Rayburn Building
Washington, DC 20515

RE: H.R. 5593

Dear Tom:

Al Cobb has provided us with a copy of H.R. 5593, the "Clean Coal Production and Utilization Technology Demonstration Act" which you have co-sponsored. We have reviewed this proposed legislation and would like to share our observations with you.

CILCO does support the "Findings and Purposes" identified in SEC. 2. Continuing research is necessary if we are to find cost-effective ways to utilize high-sulfur coal for applications that are significantly larger than pilot operations. With this legislation targeting applications in the 100 to 150 megawatt size, that requirement is satisfied.

Under "Technology Demonstration Program" SEC. 3. (b) (1), it is proposed to demonstrate a LIMB system capable of reducing SOx and NOx emissions by at least 50 percent burning high-sulfur coal. Since new source performance standards require SOx clean up of from 70 to 90 percent, use of the LIMB system as presently proposed would require additional back end clean up to meet SOx emission requirements. As an operating company, we would prefer to install one system to achieve SOx and NOx compliance rather than to deal with multiple systems. In addition, we believe that such systems capable of meeting new source SOx and NOx compliance are in the development stages.

One such system with which we are familiar is the low SOx-NOx burner being developed by Rockwell International. The Rockwell system appears to hold real promise and has already demonstrated high SOx and NOx removal rates, well above anything proposed by the EPA's LIMB program. We would encourage the support of Rockwell's system or equivalent systems. I am enclosing a brochure regarding the Rockwell International burner.

Both the LIMB system and the Rockwell system are "burner removal systems." That is, both systems introduce limestone with coal at the burner. Although SEC. 3. (b) (5) refers to additional or alternative programs to those specifically mentioned in the legislation, we believe that since the Rockwell program is so far along that it could be specifically mentioned as a possible program to satisfy SEC. 3. (b) (1).

Item (2) under SEC. 3. (b) calls for an "...atmospheric fluidized bed combustion boiler..." We would encourage investigation into the circulating solids fluidized bed boiler in contrast to the more conventional non-circulating fluidized bed boiler system that is referred to in this section of the legislation. Non-circulating systems are being built by Electric Power Research Institute (EPRI), TVA and Duke Power. By specifying a circulating solids fluidized bed boiler program it would be possible for this legislation to avoid duplicating efforts that are already underway.

Since there is little or no operating experience with circulating solids fluidized bed boilers, this would be a logical area for the federal government to investigate such a program. I am attaching a brochure on Stone & Webster's solids circulation boiler which holds real promise and should be investigated further.

SEC. 3. (b) (4) refers to coal cleaning facilities. We recommend that the thrust of this activity be towards reducing the cost of operating the coal processing facilities so that the price of the clean coal is competitive with other SOx clean up systems. CILCO, by the way, has used clean coal for many years before the installation of other pollution control equipment.

SEC. 3. (c) deals with programs to demonstrate second generation technologies. Item (2) refers to a gasification combined cycle facility. We would encourage the federal program to support the already existing Allis Chalmers Kilngas Project. Specifically, we would urge help to fund the remaining phase of installing and operating combustion turbines using gas produced by the now completed and operational gasifiers which currently utilize high-sulfur Illinois coal. As you are aware, this facility is installed at Illinois Power's Wood River generating station in Alton, Illinois.

Federal support of the existing Kilngas Program would avoid duplication and provide the needed assistance to complete the full demonstration of this system and thus satisfy the intent of this item (2).

Under SEC. 3. (c) (3), while we support the goal of operating a fuel cell on coal-derived gaseous fuel, present work indicates that such a system would be very expensive to install. I am enclosing a table relating to these costs. Perhaps the federal program could be specifically directed to determining whether the apparent high construction costs of this type of project could be realistically reduced.

Tom, I hope our comments will prove beneficial in possibly restructuring this legislation to help provide meaningful solutions to the use of high-sulfur Illinois coal. With Al Cobb's help, we had the opportunity to meet with officials from Peabody Coal Company who were instrumental in drafting this legislation. I discussed the points that we are making to you in this letter with them. We did not at that time agree to any substantive changes. We did agree to meet with Peabody's personnel in St. Louis at some future date to discuss our recommendations.

Please keep us informed as to the progress of this item. Thanks to both you and Al for bringing this legislation to our attention.

Very truly yours,

C. R. Neumiller
Director - Legislative &
Public Affairs

CRN/cjb

Enclosures

Phosphoric Acid Fuel Cell With Coal Gasifier

Table 1.1

POWER PLANT CHARACTERISTICS

Net Power Output	149.4 MW ac
Output Voltage	13.8 kV ac
Rated Power Heat Rate Heat rate with byproduct credits	11098 Btu/kWh 9608 Btu/kWh
Water make up, net	1550 gpm
Emissions (lb/10^6 Btu)	
NO_x	0.0016
SO_x	0.0039
Particulates	N.A.
NH_3	0.091
Start Up Time	5 days
Power Range	25% to 100% rated
Plant Footprint	34.4 acres
Total Capital Requirement (1983 constant dollars)	$1616/kW

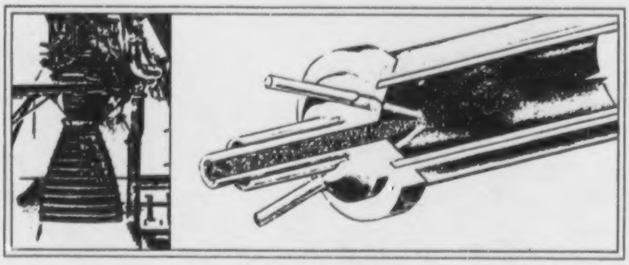
Rockwell International
...where science gets down to business

COAL-FIRED BURNER WITH LOW NO$_x$-SO$_x$ AND PARTICULATE EMISSIONS

Coal-Fired Burner with Low N

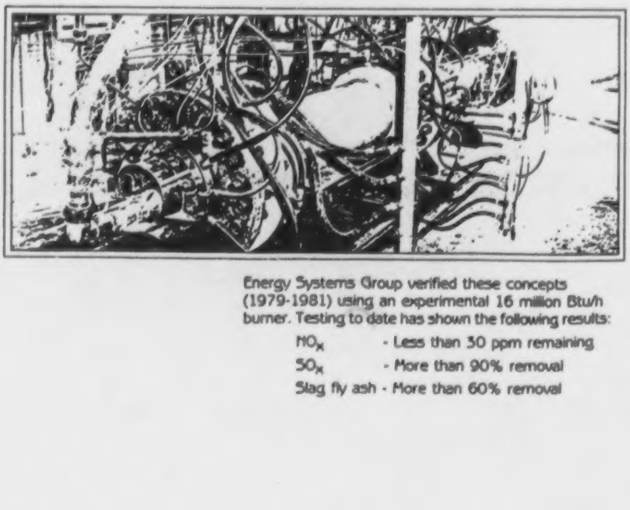
Burning of fossil fuels require control of Nitrogen Oxides (NO_x)-Sulfur Oxides (SO_x) and particulates to meet the clean air act of 1977. Future emission control requirements may require more stringent control of both NO_x-SO_x emissions. Rockwell International's Energy Systems Group (ESG) has an advanced coal-fired burner in development that achieves control of these air pollution emissions within the combustion process.

EXPERTISE IN COMBUSTION ANALYSIS FROM ROCKET ENGINE DEVELOPMENT



In the late 1970s, theoretical combustion analyses at Energy Systems Group revealed unique concepts for the simultaneous control of both NO_x-SO_x during the combustion of fossil fuels containing both sulfur and nitrogen.

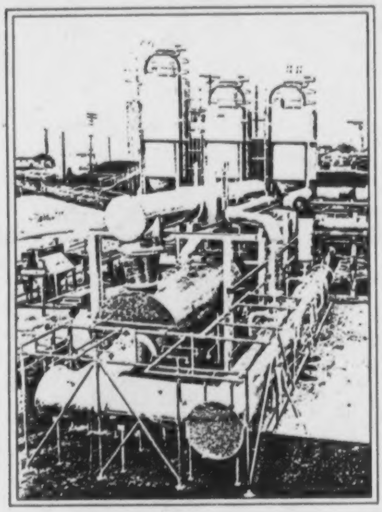
COMBUSTION THEORY VERIFIED BY EXPERIMENT



Energy Systems Group verified these concepts (1979-1981) using an experimental 16 million Btu/h burner. Testing to date has shown the following results:

NO_x	- Less than 30 ppm remaining
SO_x	- More than 90% removal
Slag fly ash	- More than 60% removal

)$_x$-SO$_x$ & Particulate Emissions...

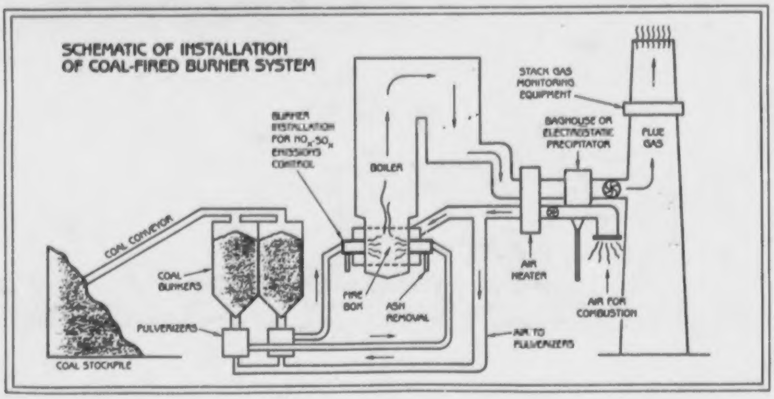


PILOT TEST FACILITY

The successes demonstrated by these tests have resulted in further commitment of substantial Rockwell resources for installation of a pilot-scale (25 million Btu/h) combustor and test facility. A utility consortium has been formed to guide the burner development and provide demonstration sites.

BURNER APPLICATION FOR NO$_x$-SO$_x$ EMISSIONS CONTROL

Burner development is now underway. Our primary objective is to provide a burner system that will allow the retrofit of gas/oil-fired utility boilers to coal without the need for stack gas scrubbers for air pollution control. Applications to new coal-fired utility boilers and to a wide range of industrial systems are also under development.



SCHEMATIC OF INSTALLATION OF COAL-FIRED BURNER SYSTEM

FOR FURTHER INFORMATION CONTACT:

ROCKWELL INTERNATIONAL
ENERGY SYSTEMS GROUP
MARKETING DEPARTMENT
8900 DE SOTO AVENUE
CANOGA PARK, CALIFORNIA 91304

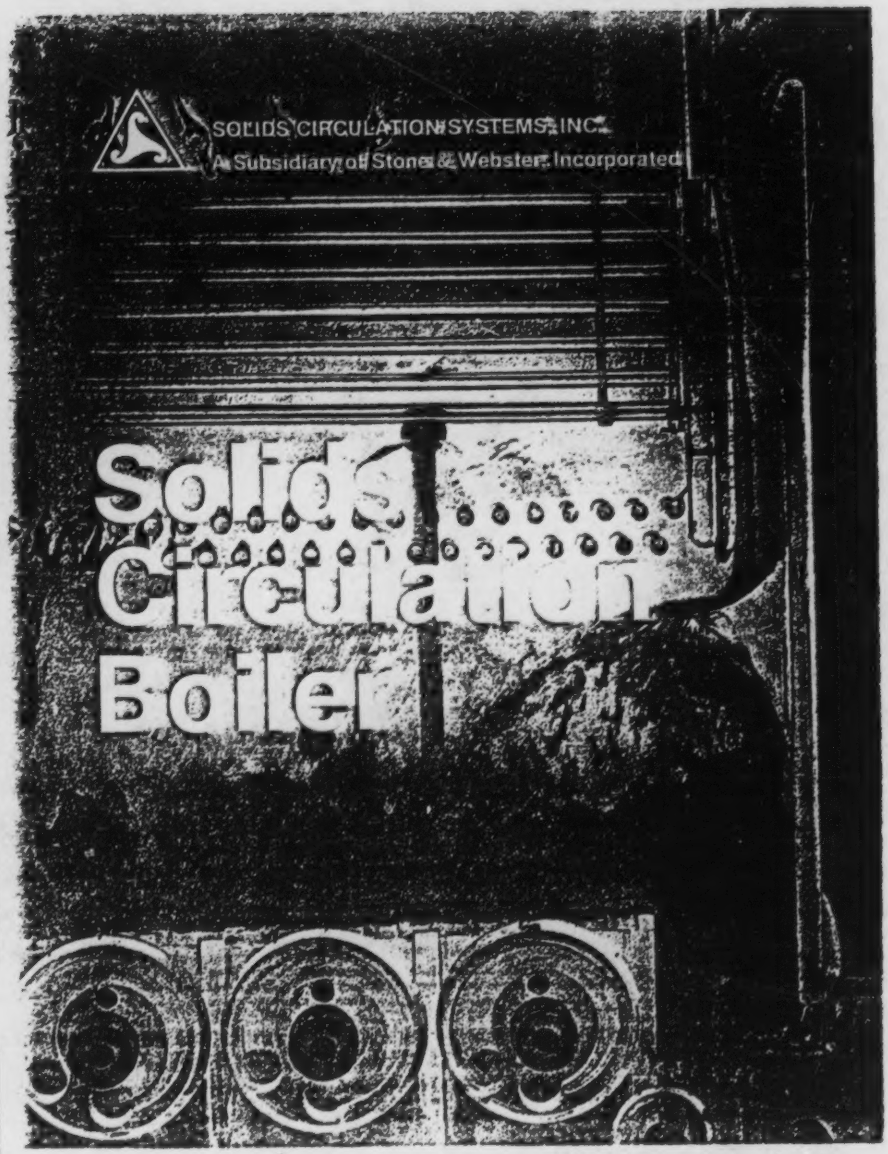
(213) 700-4016

Rockwell International
...where science gets down to business

© ROCKWELL INTERNATIONAL 1983

Copyright © 1983 by Rockwell International. All rights reserved.
This material, or parts thereof, may not be reproduced in any
form without written permission of Rockwell International.

PRINTED IN U.S.A. PUB 523-N-68-NEW 2/83



SOLIDS CIRCULATION SYSTEMS, INC.
A Subsidiary of Stone & Webster, Incorporated

Solids
Circulation
Boiler

The Solids Circulation Boiler

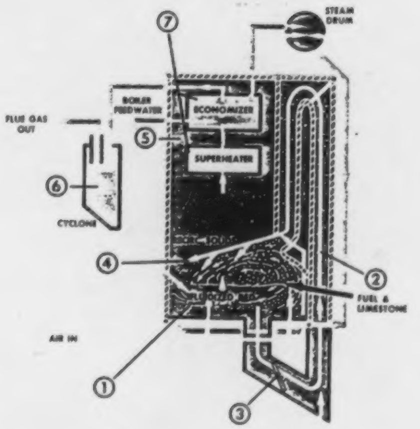
U.S. Patent 4,240,377

Applications

- Steam generation
- Cogeneration
- Steam flooding
- Process heating

Advantages

- Rapid and controlled turndown capability
- High carbon efficiency over entire load range
- Simple coal and limestone feed system
- Wide range of useable fuels
- High sulfur capture
- Low NO_x emissions
- Fast start-up
- Compact design
- No tubes in bed
- No continuous bed purge
- No erosion experienced on test units



COMPOSITE FLOW DIAGRAM

Solids Circulation Boiler Operating Concept

① Combustion is carried out in a highly agitated circulating fluid bed of inert material. Fuel and limestone are introduced to the combustion zone where they are very rapidly distributed throughout the bed by the swirling action of the solids.

② Steam is generated by passing hot solids from the combustion zone through a water walled channel in first an upward and then a downward flow, using secondary air as the solids transport medium.

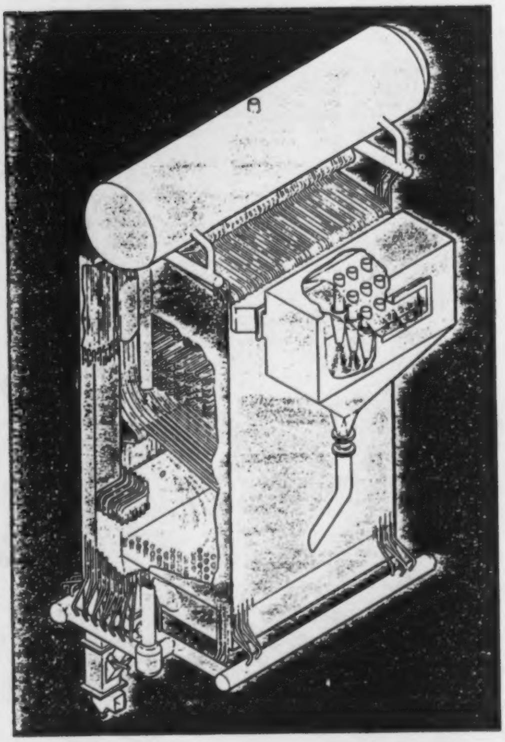
③ Steam generation rate is rapidly altered to follow large or small load swings by adjusting solids flow through the channel with a control valve.

④ Cooled solids from the downflow channel return to the combustion zone in a cascade over the bed surface with the accompanying secondary air. The cascade reduces entrainment from the bed, breaks up bubbles of gas formed in the bed, and most important, maintains the combustion zone in heat balance and thereby constant temperature.

⑤ Limestone, which has been sulfated, and coal ash, which has been ground by the bed action to a fine size, are carried overhead through the convection section where they are partially cooled with the flue gas. The inert bed material is sized such that it is not carried overhead and remains within the circulating bed.

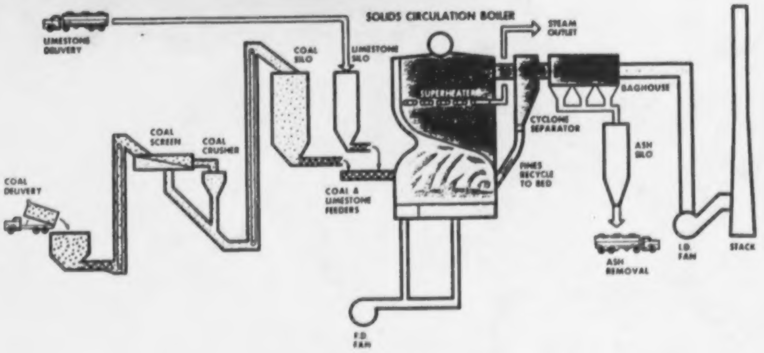
⑥ The cooled flue gas and entrained solids pass through a bank of cyclones where the coarser, partially sulfated material is separated from the flue gas and fines. The captured solids are returned to the combustion bed.

⑦ Additional evaporator surface or superheater tubes, or both, may be located in the convection sections along with the economizer section of the system.



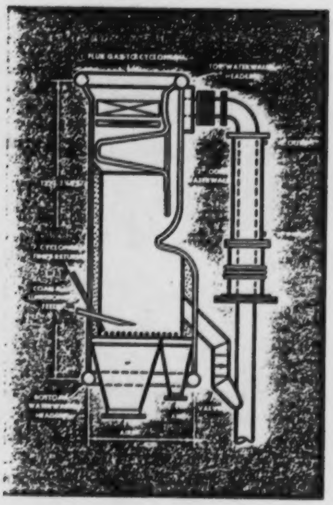
Solids Circulation Boiler

Compact Modular Boiler Design
Conventional Waterwall Construction



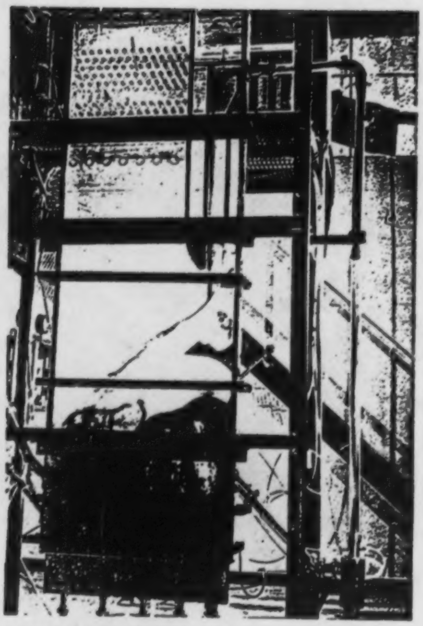
Simple, Compact Plant Design
Proven Auxiliary Components

Hot Test Unit Schematic



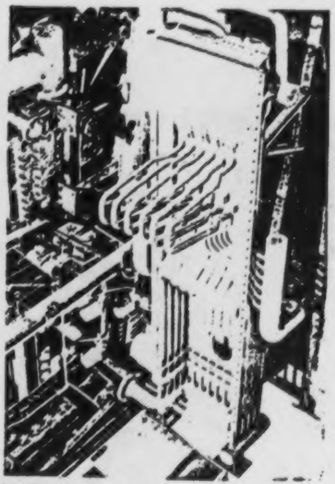
Hot Test Unit

Commenced Operation in February, 1981



Cold Test Unit

Constructed in April, 1980



Hot Test Unit Front Wall

Solids Circulation Boiler Technology licensed to Babcock Power Limited, London, England, and Foster Wheeler Boiler Corporation, Livingston, NJ

SOLIDS CIRCULATION SYSTEMS, INC.
245 Summer Street
Boston, MA 02107
(617) 589-5617

SC 8/83 AA/EED R2

Statement of

DR. ELIHU BERGMAN, EXECUTIVE DIRECTOR
AMERICANS FOR ENERGY INDEPENDENCE
Washington, D.C.

For the

SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

June 8, 1984

Mr. Chairman and Members of the Subcommittee:

I am pleased to submit this statement on behalf of Americans For Energy Independence, a national public interest organization, in connection with the Subcommittee's hearings on the U. S. Synthetic Fuels Program.

The threat to Western Alliance oil supplies created by the flareup on the Persian Gulf should be a vivid reminder of the continuing need to vigorously pursue alternatives to vulnerable sources of oil. Once again, the Western World will face deep distress in meeting its energy needs if the present level of tensions in the Persian Gulf escalates into an oil supply cut-off. Under these circumstances it is particularly disturbing that the nation's multi-billion dollar commitment to synfuels is being left to founder. This commitment to new technologies was high on the agenda for energy independence and it must be restored.

Neither the fact that the Synthetic Fuels Corporation has fallen into disrepute nor the changes in the world oil market diminish the need for a national synthetic fuels program -- any more so than mismanagement in the Department of Defense or the vicissitudes of the marketplace would diminish the value of vital defense programs. Indeed, the importance of developing a synfuels capability is as great now as it was at the height of the energy crisis, in terms of both our economic and strategic interests.

Our energy future is fraught with uncertainties which preclude confident projections of supply and demand and frustrate policymakers in both the public and private sectors. The situation in the Persian Gulf, still the main determinant of the pricing and flow of world oil supplies, will be no more predictable tomorrow than it was yesterday. Yet U.S. prospects for long-term energy security will be greatly affected by policy and investment decisions made now. We need some element of predictability in both sides of the supply and demand equation.

The American tendency to respond only to crisis situations is particularly dangerous in the energy area, where the problems and the solutions are essentially long-term and the consequences of even a short-lived crisis can be devastating far beyond its duration. The energy shortages and whopping increase in oil prices triggered by the Arab oil embargo, whose tenth anniversary we marked just months ago, showed us just how devastating the impact can be. A second price shock in 1979-80, following the Iranian revolution, alone drained $1 trillion of economic growth out of the Western industrial countries, contributing to a deepening worldwide recession from which we are just now beginning to recover. This country and its allies cannot afford another energy crisis.

It must be understood that none of the new sources and technologies which have the potential to permanently end our energy vulnerability can compete on a flat-out basis with oil at current prices. They will be competitive if oil prices rise -- more likely a matter of "when" than "if" -- and, of course, they will be very marketable if there is not a lot of oil around to compete with -- again, more a matter of "when" than "if," particularly in light of the escalating lunacy throughout the Middle East. The Catch 22 is that new supplies will never be available for tomorrow's market if we attempt to develop them only under today's strict market criteria.

Although the free market approach to energy development still merits our support, consideration must also be given to the national interest aspects of energy dependence. A country vulnerable to an energy supply disruption is a country deficient in its national security. It is, therefore, entirely justifiable and warranted to assess the free market a national security premium to achieve energy independence. We are not talking about ideological economics, but about the economics of survival.

The U.S. commitment to synfuels was undertaken to meet long-term energy objectives and it should not lightly be abandoned. It was a decision designed to deal with energy problems which remain unsolved, if temporarily obscured by the worldwide recession and oil glut. And it was a giant, concrete symbol of American determination to reassert control over our own energy future and leadership in an energy technology with major international significance.

The facts are that the synfuels option, unlike many other "exotic" sources and technologies which have captured the nation's imagination, is well within the U.S. capability; that synfuels have unique promise in the area most difficult to find substitutes for oil, namely liquid fuel uses; that first-hand experience and know-how are critical to the development of this option; and that in view of the long lead-time required to bring the products on line, our failure to gain that experience through projects undertaken now will seriously impair our ability to press synfuels into service when they are urgently needed.

In recognition of the unique situation of synthetic fuels, the Synthetic Fuels Corporation was created as a semi-independent lending institution to allow for an innovative, flexible approach to assist the private sector in assuming its key role in the development and commercialization of the most promising technologies. It is not the idea but the Board that has gone bad, undermining the confidence of industry, the Congress, and the public, and hamstringing a program which is critical to the nation's energy security.

It is time to replace the Board with the kind of leadership that can regain respect for the Corporation and its task and work with Congress to make whatever changes in its functions and targets are necessary to reflect past experience and current market realities. The pursuit of foreign investment to develop products which have an export as well as a domestic potential, which would both relieve our economic burden and provide our allies with reliable energy sources, is just one example of an area where a distinguished Board with imagination and a sense of purpose can make the difference between success and failure.

Problems associated with the flow of oil are beyond our control; problems flowing from the bureaucracy are not. We must recognize the difference and act accordingly. If we backtrack now, we will no doubt find ourselves in the coming decade waxing nostalgic over the days when we had the luxury of debating the economics of synfuels in a declining oil market.

STATEMENT OF

JOHN M. WOOTTEN

DIRECTOR, RESEARCH AND TECHNOLOGY
PEABODY HOLDING COMPANY, INC.
ST. LOUIS, MISSOURI

ON

CLEAN COAL PRODUCTION AND UTILIZATION TECHNOLOGY DEMONSTRATION ACT

SUBMITTED TO THE

SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS
U.S. HOUSE OF REPRESENTATIVES

WASHINGTON, D. C.

JUNE 7, 1984

Mr. Chairman, Members of the Subcommittee,

Peabody Holding Company, Inc., the parent company of Peabody Coal Comany, wishes to go on the record in support of the Clean Coal Production and Utilization Technology Demonstration Act, H.R. 5593. Peabody Coal is the largest coal producer in the U.S. with active operations and reserves in both the low-sulfur coal producing areas of Appalachia and the west, as well as the high-sulfur coal producing areas of the Midwest. Peabody is concerned that, in the face of every increasing pressure for reducing acid deposition, there be available economically viable, demonstrated technologies to reduce acid deposition precursor emissions from direct coal combustion.

Acid Precursor Control

As the Subcommittee is aware, a number of acid deposition control bills have been introduced in both Houses of Congress. Most of these bills require major reductions (50 percent or more) in utility SO_2 emissions. These major SO_2 emission reductions are to be achieved at the earliest by 1990 and the latest by 1995. To design, procure, construct, and place in operation a utility sized emission control system takes approximately four years once the decision to proceed has been made. Therefore, the utilities will be required to select from those technologies, which during the period 1986 thru 1990, either are, or will have been, demonstrated on a utility scale (100 megawatts electric or greater) and at an acceptable cost to be capable of reducing SO_2 emissions from existing power plants.

The question that must be addressed by this Subcommittee is: "Do the control options of either fuel switching with its inherent unemployment impact or retrofitting flue-gas desulfurization systems (scrubbers) with its significant capital costs represent the best alternatives for reducing SO_2 emissions from existing power plants, or should the commercialization of promising new technologies be stimulated by providing increased federal funding so that they will be available in the 1986-1990 time frame?" Peabody believes that (1) fuel switching and scrubbers represent, in many instances, undesirable control options and (2) the Federal government must assist the private sector to ensure the timely development of the more promising technologies to reduce SO_2 emissions from existing power plants, thereby reducing or eliminating the unemployment and cost impacts associated with present options. The following discussion provides the basis for Peabody's position and our desire that the provisions of H.R. 5593 be enacted into law.

Importance of Realistic Compliance Dates

However, before discussing the basis for Peabody's support of H.R. 5593, I think it is only appropriate to point out that one other ingredient is essential, and that ingredient is time. In realistic terms, it takes at least four years to engineer, produce, and install a proven precursor control system of any magnitude. The second generation technologies addressed in H.R. 5593 -- advanced coal cleaning, Limestone Injection Multistage Burner (LIMB), Atmospheric Fluidized Bed Combustion (AFBC), and Dry SO_2 Scrubbing -- will not be commercially demonstrated for large-scale utility applications in time to be of use in complying with a 1990 deadline such as that set forth in H.R. 3400. This will be true even if the funding levels authorized in the bill are accepted, since there is no way to complete the installation phase, much less the testing phase, by the end of 1986. And so, while we may speak of promising technologies in this

Subcommittee, it is important that your collegues on the Health and Environment Subcommittee and the full Energy and Commerce Committee understand that good engineering design takes time, and implementation schedules must be realistic. Simply stated, if acid rain control legislation does pass, it must not preempt the use of emerging technologies. Compliance dates in the late 1990's would represent a reasonable target if -- and the "if" is why H.R. 5593 is so important -- if these emerging technologies are adequately funded by the public and private sectors.

Four Promising Technology Areas

I would now like to address my remarks to the four areas of technology I mentioned earlier by briefly describing them, their present state of commercialization, and by recommending additional initiatives to bring them to commercialization.

The direct combustion of coal using conventional furnace technology produces three major pollutants: particulate matter, sulfur dioxide and nitrogen oxide. Two of these pollutants, sulfur dioxide and nitrogen oxide, are precursors for acid deposition and coincidentally are difficult and expensive to control at high levels of removal. Sulfur dioxide results entirely from the conversion of the sulfur in the coal during combustion, while NO_x results primarily from the high temperature conversion of the nitrogen in the combustion air as it passes through the furnace. The nitrogen found in the coal itself can also be converted to NO_x, however, it usually does not contribute significant amounts to the total NO_x emission concentration.

Since the amount of SO_2 emissions is a direct function of the amount of sulfur in the coal, control strategies include removal prior to combustion (pretreatment), during combustion, or after combustion (post combustion). NO_x, on the other hand, can be controlled by either lowering combustion temperatures or limiting the time the combustion air is subjected to higher temperatures.

Physical Coal Cleaning

Physical coal cleaning is a process that is capable of removing sulfur from coal prior to combustion. The process typically entails grinding the coal and floating it through water or another heavier medium. During the washing stage, the combustible portion of the coal (primarily carbon) will float, while the non-combustible heavier portions of the coal will sink. This accomplishes SO_2 control in two ways. First, a portion of the pyritic sulfur in the raw coal is removed with the non-combustible material (10-50 percent). Secondly, with the non-combustible material removed, the heat content of the remaining coal is increased. This lowers the amount of coal which must be burned and, therefore, lowers the amount of sulfur released per unit of energy input.

Physical coal cleaning is widely practiced by coal producers today, and its value as a cost-effective means to reduce SO_2 emissions is recognized. The one major drawback is that the removal rates are relatively low compared to the combustion or post combustion technologies since only the inorganic sulfur is reduced.

DOE has recognized the importance of physical coal cleaning R&D and has funded much work in this area. In FY 85, the control technology and coal preparation program of DOE will contain a new effort to determine if advanced coal cleaning technologies have the potential for use as acid rain precursor control options. The results of this investigative effort should be extended to allow funding for demonstration of these advanced coal cleaning and technologies on a commercial scale, i.e. facilities processing at least 50 tons per hour of coal achieving a minimum total sulfur removal of 50 percent with a design removal of 90 percent.

Limestone Injection Multistage Burner

A technology for removing sulfur dioxide during combustion involves the injection of a sorbent into the boiler, either with the coal or separately. The sorbent, which usually is a sodium or calcium based material, reacts with the sulfur dioxide to form a sulfate particle which can be removed from the combustion gases by the particulate control equipment.

Research on sorbent injection has been ongoing since the early 1970's with only limited success. Generally, poor SO_2 removal has resulted when lime or limestone has been used. In addition, because a foreign non-combustible substance is being injected into the boiler which can cause its operational characteristics to change. For example, there may be more slagging, and fouling may increase. Also, since additional particles enter the combustion gases, the particulate control devices may need to be upgraded. These potentially adverse operational effects may not be warranted by the low SO_2 removal achieved.

In recent years, however, a variation of the sorbent injection technology has emerged which has the potential to achieve moderate SO_2 removal (50-60 percent). This technology, known as Limestone Injection Multistage Burner or LIMB, is being researched by the USEPA and the private sector.

LIMB has much to offer as an acid precursor technology. First, it is a retrofit technology which theoretically can be applied to a large percentage of the existing utility and industrial boilers at a cost one-half that associated with existing post combustion technology (Flue-Gas Desulfurization systems or scrubbers). Second, unlike a scrubber, LIMB can reduce both SO_2 and NO_x emissions. Thus, it addresses both major acid rain precursors. LIMB technology, however, still has a number of technical problems which must be resolved before it can be considered commercially available.

The FY 85 DOE coal program budget does not contain funding for LIMB research. To date, the federal R&D effort on LIMB has been done by USEPA at its Industrial Environmental Research Laboratory in Research Triangle Park, North Carolina. The program plan calls for 50/50 co-funding by EPA and the private sector to design, construct and demonstrate LIMB technology on a wall-fired boiler by 1988 and on a corner-fired boiler by 1990.

Peabody recommends that additional funding be provided for the LIMB development program. This can be accomplished in a number of ways. For example, a decision to fund two commercial-sized demonstrations of 200-300 Mw, even at a cost of $100/Kw, will require $50 million in funding. Allowing for contingencies, this figure could mean a total private sector contribution of more than $25 million from two host utilities or a consortium of interested parties. These funding levels plus the uncertainties associated with an extremely tight schedule could create a major impediment to the LIMB demonstration effort. If additional funding were provided this impediment could be greatly reduced.

Another participation strategy would be to establish a number of smaller LIMB demonstration projects that can utilize a variety of coal types and boiler configurations. This concept would entail either a retrofit of several smaller utility boilers or a portion of a small boiler's combustion system. The object of this program would be to expand the retrofit design data base to enhance the universal application of LIMB.

Fluidized Bed Combustion

Fluidized bed combustion, FBC, is a combustion technology which is new for utility applications, but it has been used a good deal for industrial applications in Europe and the U.S. The technology involves the burning of coal in a bed of limestone particles. Air is injected beneath the bed suspending the burning coal/limestone mixture so that it resembles a fluid. Sulfur dioxide is captured by the limestone, producing calcium sulfate particles which are drawn off the bed with the ash. NO_x emission levels also are significantly reduced because the combustion temperature is approximately one-half that of a conventional boiler.

There are a number of FBC demonstration projects being conducted in the U.S. today. The largest of these is the atmospheric fluidized bed combustion (AFBC) demonstration being conducted by the Tennessee Valley Authority, Duke Power, the Electric Power Research Institute and the state of Kentucky. Peabody has recently announced its intention to commit up to $4 million to this project. The demonstration plant will be constructed at an existing TVA plant site in Paducah, Kentucky beginning in early-1986, with completion scheduled for mid-1989. Following initial start-up and shake down, a nominal four-year test program will be initiated.

DOE has increased the FY 85 funding level for the combustion systems program area to include $15 million for the development of the start-up and operational test plans for the Paducah project. An additional $15 million is to be made available in FY 1986. The total FY 1985 combustion systems funding request is for $17 million which leaves only $2.5 million for additional combustion work.

In Peabody's view, program funding should be significantly expanded to allow DOE to play a larger role in the development of other AFBC technologies. Specifically, two recommended areas for DOE participation are the circulating AFBC project being undertaken by Colorado-Ute Electric Association at its Nucla Station, and the conversion of a boiler to AFBC by Northern States Power Company at its Black Dog Station.

Colorado-Ute proposes to use a significantly different AFBC design, a circulating fluidized boiler (CFB). Rather than burning the coal/limestone mixture in a fixed bed, the air is injected at a much higher rate which in turn expands the bed throughout the entire combustion chamber and causes the solid combustion products to be entrained in the combustion gases. The solid combustion products are then removed from the gas and recycled to the CFB. This recirculation offers the potential for improved combustion efficiency and more complete utilization of limestone.

Colorado-Ute expects to order the CFB boiler in late-1984, initiate construction by mid-1985, begin operating the system in early-1988, and complete a two-year test program by early-1990. To date, this project has not been targeted to receive any federal funding. H.R. 5593 would allow the sponsors of this project an opportunity to secure funding at least at the same level as the Paducah AFBC project.

Northern States Power is also taking a unique and important approach to demonstrating AFBC technology. They are proposing to convert an existing conventional coal-fired boiler to an AFBC boiler. Procurement of the boiler conversion package is expected to occur by mid-1984, and construction is to be completed by early-1986. A preliminary survey of installed utility capacity in the U.S. has indicated that approximately 150 boilers, totaling over 20,000 Mw, could be converted in this manner. This is equivalent to approximately one-third of the capacity which would be required to retrofit scrubbers by H.R. 3400. Here again, Peabody recommends that DOE be allowed to offer the sponsors the opportunity to secure the funding levels required to ensure this project goes forward according to schedule.

A number of options appear to be available for DOE to participate in these two additional projects, including direct funding of a portion of the capital costs, or funding for the design and execution of the testing program. Another option would be to fund test burns using Northern Appalachian or midwestern high-sulfur coal. Both projects are currently targeted to achieve at least a 70 percent removal rate using low-sulfur western coal.

Dry Flue Gas Desulfurization

The development of flue gas desulfurization processes that produce a dry discharge or sludge have only recently been applied to utility sized facilities. There currently are 6 operational systems on utility boilers, 7 under construction, and 4 for which contracts have been awarded. These 17 dry FGD units represent 6,873 megawatts of scrubbed capacity or 6.5 percent of the total scrubbed capacity in the U.S. None of these installations utilize high sulfur coal (sulfur content greater than 2.5 percent by weight) even though the technology has the potential for lower installed cost, lower maintenance and energy requirements. In addition, the technology generates a dry sludge making disposal easier and by virtue of it being a simpler technology than wet scrubbing, it is easier to operate.

Dry scrubbing has been applied to industrial boilers burning high sulfur coal. One such installation is a 170,000 pounds of steam per hour boiler at Argonne National Laboratory near Chicago, Illinois. SO_2 removal efficiencies in excess of 90 percent have been achieved on a 3.5 percent sulfur coal. In addition, a dry FGD system installed at the Northern State Power Company's Riverside Station in Minneapolis has been tested on 3 percent sulfur coal. The tests were short term, however 90 percent SO_2 removals were demonstrated.

The potential operational and economic benefits of dry FGD and the industrial and utility test experience warrant that this technology be demonstrated on a utility sized boiler burning high sulfur coal. H.R. 5593 would provide the necessary opportunity for a full scale demonstration of this technology.

Advanced System Demonstrations

The bill also provides for the demonstration of advanced longer-term coal utilization technologies. Peabody believes that this, too, is a needed component. In the future, when new energy facilities are constructed to replace existing facilities or accomodate growth, these facilities should utilize technologies that minimize environmental impacts. Coal is the nation's most abundant energy source and it is important that advanced technologies for the direct combustion of coal or its conversion to alternate fuels be developed on a commercial scale. The private sector cannot shoulder the entire technical and financial risk for demonstrating these technologies. H.R. 5593 provides the necessary link to bridge the now existant gap between proof of concept work and full scale demonstrations.

DOE's Traditional Research Role

Traditionally DOE was limited in its involvement in energy research to the initial stages of basic research through pilot plant proof of concept work. The private sector then takes those technologies which appear most promising through the process development and commercialization stages. This results in only those projects that are both technologically as well as economically viable being completely developed. Under the normal economic cycle of events, Peabody supports the traditional roles of both DOE and the private sector. However, when the normal economical cycle is disrupted by legislative initiates such as acid deposition control, rendering available technologies unacceptable and not allowing ample time for fulfulling the traditional roles of technology development, complementary legislative initiatives in the area of demonstrating more acceptable technologies are required. In addition, in the field of coal combustion or coal conversion, the technical as well as economic risks can easily exceed the capabilities of the private sector. When the traditional cycle of technology development is circumvented, as will be the case with acid deposition control legislation, DOE must be provided the means to move beyond its traditional research role and assist the private sector in developing the technological response in the time frame required.

H.R. 5593 provides DOE just such an opportunity to assist the private sector. DOE will be required to solicit proposals in generic areas of technology. The private sector can respond with what it feels are the most promising technologies to be demonstrated. A degree of the traditional roles can be maintained by requiring a portion of the funding to come from the private sector. In addition, DOE and the Subcommittee can exercise control of the program through the development of the five-year plan.

Peabody Position

Peabody is concerned that acid deposition control legislation as it has been proposed to date may, because of unrealistic compliance deadlines, preempt the application of new technologies for acid precursor control from direct coal combustion. Current control options in most situations will cause adverse employment and economic impacts. Therefore, Peabody supports the enactment of H.R. 5593 to allow DOE the opportunity to stimulate the commercial demonstration of the most promising coal production and utilization technologies in a time frame consistent with reasonable compliance deadlines in the late-1990's. Hopefully the employment and economic impacts of any acid deposition control legislation that may be enacted can at the least be reduced to more acceptable levels.

Peabody will be more than willing to respond to inquiries concerning this statement.

STATEMENT BY THE TENNESSEE VALLEY AUTHORITY
BEFORE THE
SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
JUNE 7, 1984

The Tennessee Valley Authority commends the interest of Representative Lloyd and others in assisting the development of advanced technologies which would permit the continued and expanded use of a domestic resource, coal, for the production of electric power while minimizing the environmental impacts currently associated with coal-fired generation.

TVA supports and is deeply interested in the development of such technologies. Our interest is exemplified by our ongoing and planned research activities, such as atmospheric fluidized bed combustion (AFBC), flue gas desulfurization, and coal gasification processes. In addition, TVA participates in and financially supports the research, development, and demonstration (RD&D) efforts of the Electric Power Research Institute (EPRI), which conducts research in many types of power generation technologies.

For example, TVA is a leader in the field of AFBC research. We recognize that, in order to achieve rapid commercial acceptance by the electric power industry, this particular technology needs a utility-scale demonstration to verify operability, reliability, performance, and costs. TVA, with significant support from Congress, took the first major step leading to a utility-scale demonstration by constructing a $68 million, 20-MW AFBC pilot plant in Paducah, Kentucky. The unit began shakedown operations in May 1982. A major test program, funded jointly by EPRI and TVA, is underway to develop the technical and environmental performance data to be used in the design and construction of a demonstration plant. After the initial 42-month test program ends in FY 1986, the pilot plant could be made available to support other related research and development activities.

TVA, in a joint project with Duke Power Company and the Commonwealth of Kentucky, has joined with EPRI in the demonstration of a 160-MW AFBC boiler. We are in the process of detailed engineering design for this effort and hope to complete funding arrangements within the next several months. DOE is providing TVA $30 million toward this effort.

The AFBC demonstration facility will be located at TVA's coal-fired Shawnee Steam Plant in Paducah, Kentucky. To demonstrate the technology, an AFBC boiler would be constructed beside the plant as a replacement for the existing boiler. The AFBC boiler would be capable of generating approximately 160 MW of electric power and would make maximum use of the existing turbogenerator set and other associated equipment. The design fuel for the demonstration would be high-sulfur Illinois basin coal, as typified by Kentucky number 9. However, fuel flexibility will be considered, with testing of alternate fuels during the test program. The preliminary cost estimate for construction of the AFBC demonstration facility at

Shawnee is $200 million. It is anticipated that a 3-year test and demonstration period will cost approximately $20 million above normal operating costs.

TVA is in total agreement with emphasizing environmental protection as an important consideration in technology development and, in particular, recognizing the need to control sulfur emissions from conventional coal-fired plants. We have been actively researching scrubber technology for more than a decade and are currently operating a scrubber test facility at our Shawnee Steam Plant. TVA is considering constructing a 10-MW test facility and a 160-MW dry flue gas desulfurization (spray dryer) demonstration unit utilizing lime, which would meet the general requirements of the unit described in section 3(b)(3) of the bills. TVA has requested and expects to receive proposals from interested spray dryer vendors in the near future. We are hopeful that cooperative funding arrangements between the parties can be developed to allow these projects to move forward. Our plans call for a 2-year test program and, if successful, follow-on commercial operations.

Approximately two-thirds of the coal burned by TVA is washed either at the mine site or at a TVA-operated facility. Thus, TVA would be interested in any research into the development of a unit as described in section 3(b)(4) of the bills. TVA's program focuses on process improvements, process control, and resource recovery, such as the high-gradient magnetic separation technology, which is being demonstrated at Paradise Steam Plant. This technology will improve Btu recovery and sulfur reduction in the fine-coal washing circuit.

A major TVA research program involves the demonstration of prompt neutron activation analysis techniques, rapid sulfur meter (RSM), and continuous online nuclear analyzer of coal (CONAC) to monitor and control coal-wash plant operation. Testing of RSM and CONAC is now underway at Paradise. For CONAC, in addition to its use in the quality control and optimization of coal cleaning operations, we will investigate its applications to real-time, best-rate control; optimization of power system load dispatch; and boiler slagging and fouling control.

Coal cleaning, however, is one of several technological areas mentioned in the bills where TVA believes increased R&D emphasis should be considered. If enhanced coal cleaning by such methods as chemical or electrochemical cleaning can be developed, utilities would be able to burn a wider range of coals while minimizing undesirable waste from the cleaning process.

In addition to the program areas discussed above, TVA is conducting research and has expertise in several technologies described in section 3(c) as longer term, second-generation technologies. These efforts focus on coal gasification and fuel cells.

TVA has built a coal gasification plant at Muscle Shoals, Alabama, which cost approximately $42 million. It was constructed to demonstrate the use of coal to produce a synthesis gas which is then used to make ammonia, the key ingredient for making nitrogen fertilizers. The facility features the most up-to-date technology in coal gasification and purification. Although conceived as a project to protect the Nation's food production capability, it has significant potential for and has attracted the interest of the chemical and energy industries.

TVA's ammonia-from-coal facility is capable of processing about 200 tons of coal daily into a synthesis gas mixture of hydrogen and carbon monoxide, using the high-pressure, slurry-fed Texaco process. The Muscle Shoals plant is the only large-scale facility in the United States that is both functional and available for test work on a variety of coal-based synthesis gas or energy-related advanced concepts and projects. The present technical condition of the plant is quite good, and we believe that this facility could be operated over a period of several months with an on-stream factor of more than 75 percent. The current test program should be completed in FY 1985, and thus, the plant will be available for further research if it is needed and suitable funds are available.

We are pursuing further a commercial coal gasification venture with the North Alabama Coal-to-Methanol Project. Methanol has been selected as the end product since we believe the more promising early applications of synthetic fuels would be in the nonelectric sector.

A next logical generation of gasifiers to be demonstrated would be pressurized, dry-feed entrained bed designs, such as are being developed by Shell Oil Company and Krupp-Koppers. A 1,000-ton-per-day unit--about 100 MW--would be an appropriate size to follow the test units now available or being built. Similar processes and economic advances in gasification and liquefaction of coals could potentially open up a much wider market for the products, while minimizing undesirable by-products of such processes. We think enhanced activities in these areas should be investigated. Our fuel cell research centers around our 250-kW, ribbed substrate, phosphoric acid fuel cell stack. Our objectives are to determine the long-term durability, operability, and efficiency of the stack at conditions which simulate the application of a fuel cell stack as an electric utility power generator, including operation as a cogenerator, and with simulated coal-derived fuel. We are investigating the possibilities of demonstrating this fuel cell at a user site.

Continued efforts to see that appropriate attention and resources are committed to developing power generation technologies are vital to TVA and the electric power industry. Additional emphasis on the development of high-priority alternative technologies and related areas could significantly assist the electric power industry in its efforts to make more extensive use of coal, which is in plentiful supply domestically, in an environmentally acceptable manner. In this regard, TVA firmly supports further and more extensive RD&D work on such advanced technologies, and we appreciate this opportunity to present information on TVA's activities in this area.

COMMENTS BY THE

ROCKY MOUNTAIN OIL AND GAS ASSOCIATION

COMMITTEE ON OIL SHALE

SUBMITTED TO THE

HOUSE SCIENCE AND TECHNOLOGY COMMITTEE

SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS

JUNE 20, 1984

The Committee on Oil Shale of the Rocky Mountain Oil and Gas Association appreciates this opportunity to submit our written comments on the National Synthetic Fuels Program.

First, we would like to give you a brief background on oil shale and why a national synthetic fuels program is necessary. Then we will conclude with recommendations on how to improve the current program.

About 15% of the world's oil shale resources are found in North America. The Green River Formation deposits in Colorado, Utah and Wyoming are among the nation's greatest untapped energy resources. The U.S. Department of Interior estimates that of the 1.8 trillion barrels of oil in place, at least 600 billion barrels are recoverable by today's technology. These oil shale reserves are estimated to be more than 90% of the world's proven conventional crude oil reserves. There have been commercial oil shale operations in many countries in the past. In most cases, operations ended when it was found to be cheaper to import crude oil than to continue to produce shale oil. But in China and Russia, operations continue today.

Since the turn of the century, oil shale development has been talked about, studied and planned for many times by many different companies. However, its development has always been clouded by an atmosphere of uncertainty. It's a business based on extremely high capital costs--even small commercial size projects will cost over a billion dollars. The development of oil shale has been subject to world oil prices with production costs considerably higher than conventional petroleum sources.

The oil shale industry is a business based on technical uncertainties. Development of oil shale on a large scale, dependable and efficient basis does have risks. But these risks can be overcome and the companies in this business are used to taking technical risks.

It is also a business that is trying to develop within the context of changing national priorities and policies. Changing governmental tax policies, as well as changing regulatory and environmental policies can and do off-set greatly the prospects for development. The synthetic fuels industry has not had the luxury of knowing what the ground rules for development will be from one year to the next.

The 1980 Energy Security Act was designed to make this country less dependent on outside, unreliable sources for its supply of petroleum. Oil shale has rightly become one of the domestic sources of energy targeted for assistance under the Act because the economics of oil shale development are favorable in comparison to most other synthetic fuel options.

If the people of this nation and the federal government maintain their commitment to the principles of the act, then a limited number of pioneer shale projects will move ahead. Once these plants have been built, the technology demonstrated and the infrastructure established, the nation will be armed with the capability to utilize the resource in a shorter time frame than is now possible.

The United States government should continue to encourage the development of a pioneer synthetic fuels industry. Our recommendations on a National Synthetic Fuels Program address the future of the Synthetic Fuels Corporation (SFC), federal tax policies, and leasing of Federal lands for prudent synthetic fuels development. Our recommendations for the future of the SFC are as follows:

1) The SFC Board should be reconstituted as soon as possible and the $14.77 billion Phase I program should be maintained. Presently, unfavorable economic conditions make private sector development of a commercial synthetic fuels industry extremely unlikely without government assistance. Government assistance will be required for the industry to move forward. Therefore, we believe that continuation of the SFC without significant reduction of its present scope is essential to the nation's commercial synthetic fuels foundation. The current SFC program provides a foundation upon which future private sector projects can be built to help meet the energy demand shortfalls which will be created by declining conventional oil production and to mitigate the effects of disruptions in foreign sources of supply. Also, many of the oil shale companies have entered into good faith negotiations with the SFC and have made substantial financial commitments to the development of a synthetic fuels industry. To alter the government's participation in the synthetic fuels program at this time would seriously jeopardize this nation's ability to develop synthetic fuels and many companies would lose all hope of recouping this significant investment in synthetic fuels in the near future. Companies with existing letters of intent by the SFC would be particularly hurt.

2) The target date for completion of the presently authorized and appropriated SFC funds should be extended to June 1987. This extension is considered necessary in order to provide sufficient time for the SFC to select and to successfully implement a logical progression of project awards in diverse

reosource and technology areas, and to measure the extent to which these projects meet production and diversity goals. Moreover, this extension will allow the SFC to gather information upon which recommendations for implementing Phase II can be based.

3) The primary emphasis during the execution of the balance of the Phase I program should remain on commercial scale projects. The Committee believes that a production goal of 100,000 barrels per day total for all commercial scale projects would be appropriate.

4) The SFC should develop the added flexibility to support semi-works level projects. This added flexibility should only be used for projects which incorporate technologies that have been demonstrated at pilot plant level, which are needed to meet the diversity goals, and which have the potential for large commercial application. A reserve on the order of $1 to $2 billion would be appropriate for support of semi-works projects.

5) The SFC should initiate an immediate review of the criteria set forth in the Energy Security Act for the selection and award of projects to determine whether the SFC's interpretation of such criteria can be changed to make investment and participation by the private sector more attractive. The risk-to-reward ratios now allowed by the SFC are much too high to attract equity investors. If it is determined that the Act's criteria are properly interpreted, then changes in the Act should be sought so more private sector investors will be attracted to support these projects.

6) The more mature and viable projects which have passed the present solicitation requirements should be brought to fruition.

7) The SFC should recognize and accommodate the need for a longer lead time for preparation and submission of proposals. The recently announced "Fourth General Solicitation" effectively eliminated new projects from meaningful competition.

8) Additional technological diversity should be encouraged. The SFC should promote competing technologies to develop a broader based industry.

9) The SFC should give serious consideration to additional oil shale awards, rather than constrain awards in anticipation that projects in other resource areas will reach comparable levels of maturity and equity financing.

10) The SFC should become more opportunity oriented and flexible, particularly in recognizing that the unique nature of each project may preclude any individual project from conforming with previously established criteria and award terms of other projects.

Our recommendations on federal tax policies are as follows:

1) The deadline for the energy-investment tax credit to allow companies to take advantage of the credit should be extended. The tax credit was designed by Congress as an incentive to encourage energy conservation and conversion of equipment from the use of oil and gas to the use of alternate fuels. The deadlines for obtaining these credits has expired. Given the slower rate of investment in synfuel facilities and the risks associated with projects, the deadlines should be extended.

2) Congress should also pass legislation to local communities to allow current year deductions for energy impact assistance. Most synthetic fuel development will occur in sparsely populated areas of the country where small communities will have to manage the short-term strain of rapid population growth. Many communities are requesting, or requiring, corporate assistance in the front-end capital needs for public facilities and services. Tax policies should recognize these expenses as costs of doing business.

A comprehensive federal program is needed to make public lands available for prudent development. The federal government owns about 70% of the oil shale lands which contain close to 80% of the oil shale reserves. Our recommendations on leasing of federal lands are as follows:

1) The Department of Interior should develop a sound federal leasing program. Industry recommends that Department's long-term management plans for oil shale should not severly limit future oil shale leasing through arbitrary limits.
2) The Department of Interior should push for expeditious resolution of unpatented mining claims which have been pending for nearly twenty years.
3) The Department of Interior should establish a more favorable program for the exchange of state and/or private oil shale lands for federal oil shale lands. This will enable leasing and management of such property in blocks of sufficient size to enable commercial development.

4) Congress should pass comprehensive oil shale leasing legislation to rectify many of the existing problem areas such as numererical lease holdings (one per company) and lack of off-site leasing for plant siting and processed shale and overburdened disposal.

In summary, we believe that energy security should remain an important national priority and the commercial development of synthetic fuels, particularly shale oil, should play a major role in securing our energy future. This can be achieved through the SFC's continued participation in assisting synthetic fuels projects, and government providing favorable tax and leasing policies and legislation.

The Need for Cost-Shared Solar Energy Technology Facilities, System Experiments and Demonstrations

Written Testimony
For
June 13, 1984 Hearing

SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS

COMMITTEE ON SCIENCE & TECHNOLOGY

U. S. House of Representatives
Washington, D.C.

by

Dr. J. Charles Grosskreutz, Manager, Advanced Technology Projects

Black & Veatch, Engineers-Architects
Kansas City, Missouri 64114

This testimony is presented in support of the need for federally cost-shared facilities, system experiments, and demonstrations to provide the critical links between energy technology research and development and first commercial usage. The point of view presented here is that of system design engineering, the bringing together of many different subsystems and components to produce a reliable, safe, durable, high performance system for producing energy at a cost that is competitive for the consumer and profitable for the owner.

The major problem for new energy technologies is that considerable effort must still be expended after achieving technical feasibility (i.e., they work) to reach the desirable attributes of reliability, safety, long life, high performance and cost effectiveness. That is to say, commercialization is a process, not an event. And, the process is especially risky and expensive when large, multi-component systems are required to achieve the desired end product, such as electricity. I have become especially aware of these problems by working in two particular emerging technologies: 1) the use of solar thermal energy to produce electricity by means of solar central receivers, and 2) the gasification of coal to produce fuel for combined cycle electrical generating systems. The second technology is much further developed and nearer to the goal of commercial usage, but it still requires federal subsidies in the form of loan and price guarantees from the Synthetic Fuels Corporation to attract private investment for the first large scale, pre-commercial plants, e.g., the Cool Water Project at Daggett, CA and the Great Plains Gasification Associates project located in North Dakota. The solar thermal technology has just emerged from the pilot plant stage at the 10 MWe Solar One experiment near Barstow, California. The balance of my testimony will utilize the solar central receiver technology as an example of a promising new energy source that is in need of federally cost-shared scale-up experiments and projects to bridge the gap to successful entry into the commercial market place.

The major reason that cost sharing is required lies in the fact that a solar thermal plant for electricity production is a system, composed of many subsystems: solar collectors, solar receiver/boilers, thermal storage, heat exchangers, turbine generators, and a host of interconnecting piping, controls, wiring and buildings to contain and control it all. Consequently,

- There is no one industry or manufacturer that will take the risk of complete solar thermal systems development because no one industry will ever manufacture, test and market complete utility systems and hence profit from the entire system.
- For a group of industries to spread the development risk among themselves, they must be assured of a predictable market for their subsystems to be integrated into complete solar thermal electric systems.
- To generate the market required for individual company risk investment, the system users (e.g. utilities or third party investors) must be convinced of system reliability and the O&M costs.
- If the market exists, manufacturers will work to get costs down to the point required for competitive electricity production.

The critical step in this sequence is convincing the user of reliable operation, annual electricity production (kWh/yr) and reasonable operating and maintenance costs. In other words, one or more pre-commercial plants or system experiments are required to demonstrate this performance. On the other hand, the capital cost of such plants or experiments is too large at this time for private industry to undertake except on a cost-sharing basis.

The problem can be best understood by describing in specific terms the primary needs that I perceive for continued development of solar central receiver systems that utilize molten nitrate salt as a heat transfer fluid. Small scale (5 MWt) molten salt receiver and steam generator subsystems have been designed and tested at the Central Receiver Test Facility (CRTF) in Albuquerque, New Mexico. At the present time, a Molten Salt Electric Experiment, also 5 MWt, is being tested at CRTF. This cost-shared experiment produces 750 kWe of electricity by means of a steam turbine-generator coupled to a molten salt receiver, storage and steam generator subsystems. It represents the first system-level development step along the evolutionary path to mature, large-scale central receiver plants using molten salt technology.

At the same time as these molten salt experiments have been conducted, designs for utility scale plants have been carried out for the purpose of 1) defining and resolving critical technical issues through the design process and 2) establishing supportable cost estimates for construction and operation of these plants. Conceptual and preliminary engineering designs have been carried out for several projects including a 60 MWe molten salt central receiver plant to be located at Arizona Public Service Company's Saguaro Station, some 40 miles northwest of Tucson, Arizona. The current design is for repowering Saguaro Unit One.

Attempts to secure private financing for this project have been unsuccessful thus far because of the considerable technical and economic risks in scaling up from 5 MWt at CRTF to 60 MWe (190 MWt) at Saguaro. Moreover, the reliability and availability of such large system operation has never been tested and hence the annual electrical energy production cannot be guaranteed with a degree of certainty necessary to satisfy a private investor. The solution to this problem, in my opinion, is to proceed through a series of discrete scale-up steps to test the critical receiver and thermal storage subsystems as well as the full size molten salt pumps and valves required in utility-scale plants. Black & Veatch, together with Arizona Public Service Company, has published a development plan that documents these scale-up experiments. The total cost to implement the plan, up to and including a 10 MWe intermediate scale experiment, is in the neighborhood of $100 million in as-spent dollars.

Other projects and plans exist for similar experiments and demonstrations to reduce the technical and economic risks still inherent in solar central receiver systems. At present, all of these plans and projects are essentially on hold as far as construction is concerned because of the lack of financing. Thus, the process of going from a successful technology development stage to the necessary precommercialization activities is dependent on some type of federally cost-shared program.

Why is it important that these activities not be allowed to die? A point of view and a sense of vision regarding our energy future are required to answer this question. The central theme is familiar, energy vulnerability. In the short term (10 - 25 years), our vulnerability is in the threat of oil import losses through political unrest and war. In the longer term (50 - 150 years), it is continued depletion of fossil reserves and ever increasing prices. To gain perspective on the urgency of continued technology development of alternative energy sources, it has only to be remembered that it required 40 years after the first critical nuclear chain reaction was achieved at Stagg Field in 1942 for the nuclear industry to achieve 12% penetration of the U.S. electricity market. And that remarkable achievement occurred only as a result of massive federal support along every step of the technology development and commercialization process. Thus, given the time margins just mentioned, decisions to continue new energy technology development must be made far in advance of their actual need.

The solution to energy vulnerability is to be ready with the right kind of energy at the right place and at the right time. On the other hand, the motivation for private sector investment in emerging energy technologies are profit potential, manageable risks, and a comparison with alternate strategies. Unfortunately, we cannot depend on the pace of private sector involvment to solve our national needs. In the words of Bernard Lee, President of the Institute for Gas Technology (IGT)*, "National policy must intrude into the market place and establish priority because the private sector can never factor national needs into private investment decisions."

The Energy Security Act of 1980 and the establishment of the Synthetic Fuels Corporation (SFC) were the products of the philosophy just stated. While the SFC has fallen on hard times, principally because of management problems, the philosophy on which it was based has not lost its integrity. One of the positive results of the SFC's existence has been a careful definition and implementation by SFC staff of the criteria which proposed projects must meet to qualify for SFC assistance. These criteria have been designed to provide equitable means by which emerging projects can be evaluated and compared on the basis of technical merit and strength, project structure and objectives, and financial strength and maturity. Typically, a synthetic fuels project must progress through the following stages to qualify for federal cost-sharing.

---

* 1982 State of Energy Address to the 9th Energy Technology Conference, February 18, 1982.

- Basic eligibility under the statute
- Project design maturity
- Project strength

The criteria for maturity are to have a) completed financial viability and technical feasibility studies; b) completed design work sufficient to allow accurate cost estimates; c) acquired all rights to the plant site and key technology, and the necessary utility and water inputs; and d) clearly defined estimated amounts and terms of commitment for each of the project sponsors.

The strength criteria include technology soundness; economic soundness (ability of project sponsors to sustain the project during operation); potential for compliance with health, safety and environmental regulations; potential for replication; sponsor's management capability; and product marketability.

Under competitive solicitations, the SFC has further required that a minimum of 20% of the required equity be committed to the project, that the project has a viable project financing plan, and that a management plan exists for design engineering, construction and operation of the project according to a definite, achievable schedule.

It is my belief that these principles could be applied with proper modification to the establishment of a cost-shared approach to other energy technology facilities and projects such as those discussed earlier in this testimony.

The provision of adequate energy supplies in the United States is a long-term problem, and a sustained national effort—over decades--is necessary to solve the problem.

the new SEIA

SOLAR ENERGY INDUSTRIES ASSOCIATION Suite 520 1156 Fifteenth Street, NW Washington, D.C. 20005 (202) 293-2981

042

June 13, 1984

The Honorable Don Fuqua
U.S. House of Representatives
Chairman, Subcommittee on
Energy Development Applications
B374 Rayburn House Office Bldg.
Washington, D.C. 20515

Dear Mr. Chairman:

In behalf of the Solar Thermal Division of the Solar Energy Industries Association (SEIA), I am submitting this written statement regarding the need for government cost shared solar thermal energy technology development and demonstration projects.

As chairman of the Solar Thermal Division, I respectfully request that this statement be included as part of the subcommittee's hearing record.

The SEIA industrial members wish to thank you and the members of the subcommittee for your consideration and continued support of this technology. I would be pleased to provide the subcommittee with any additional information you may require during your deliberations. Your review of positions outlined in the attached statement will be greatly appreciated.

F. F. Duquette
Chairman
Solar Thermal Division
Solar Energy Industries Association

WRITTEN TESTIMONY
FOR
HEARINGS ON
COST SHARED ENERGY TECHNOLOGY
DEVELOPMENT AND DEMONSTRATION PROJECTS
before the
SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS
COMMITTEE ON SCIENCE & TECHNOLOGY

U.S. House of Representatives
Washington, D.C.

13 June 1984

by

F. F. Duquette, Chairman, Solar Thermal Division
Solar Energy Industries Association

FOREWORD

The Solar Thermal Division of SEIA appreciates the opportunity to present this testimony in support of the need for federally cost-shared facilities, system experiments, and demonstrations which provide the critical links between energy technology research and development and first commercial usage. In this industry's view the importance of bringing together the many different subsystems and components to produce a reliable, safe, durable, high performance system for producing energy at a cost that is competitive for the consumer and profitable for the owner cannot be overly emphasized.

New and emerging solar thermal energy technologies transform solar flux into many versatile and valuable energy forms. Through concentration and heat absorption, the energy of the sun is converted into electricity or incorporated into other products such as process heat. These technologies still require considerable effort to be expended after achieving proof-of-concept to reach the levels of reliability, safety, long life, high performance and cost effectiveness required by the risk averse buyer/user.

The commercialization process is particularly difficult and costly when large, multi-component systems are required to achieve the desired end product, such as bulk electricity.

The establishment of an off-budget mechanism to provide federal government support for pre-commercial, large scale solar thermal system demonstrations in the form of grants, loan guarantees and/or price supports is strongly recommended.

This legislative thrust, along with the needed energy tax credit extension and adequate DOE technology development budget levels, will allow the industry to maintain it's position of world leadership in solar thermal technology... a leadership based upon the momentum gained during the past decade from a strong government/industry R&D partnership.

THE NEED FOR GOVERNMENT SUPPORT
of
SOLAR THERMAL ENERGY TECHNOLOGY
COMPONENT DEVELOPMENT, SYSTEM EXPERIMENTS AND
COMMERCIAL SCALE DEMONSTRATIONS

Conventional fuels will continue to provide the majority of the U.S. energy supply for the near future. During this time, however, consumers and businessess will continue to be concerned about inevitable cost increases associated with finite fuel supplies. Concurrently, for reasons of national security, employment opportunitites, high-technology development export potential, utility capacity planning, and sound energy management, it is essential to have renewable energy sources provide a growing share in a diversified energy supply mix.

Total government spending for conventional energy has been orders of magnitude higher than for renewables. Little more than $10 billion has been spent on renewables, primarily over the past decade, while more than $125 billion has been spent on conventional energy over the past 60 years, according to estimates by Battelle Pacific North West Laboratories.

These new technologies also need time. History tells us that any new technology takes many decades to become fully integrated into the energy mix.

Historically, new energy technologies have often taken decades before scientific advances have led to commercial products. Research by the International Energy Agency has found that even after the first commercial units have been introduced, decades more are normally required before large scale commercial development occurs.

Market Penetration Time for Energy Technologies

Energy Technology	Time from proof-of-concept to first commercial unit	Additional time required for significant market penetration (approx. 10-50% of mkt.)
Nuclear	16 years	20 years
Diesels	60 years	30-50 years
Pulverized coal	25 years	15-18 years
Heat Pumps	30 years	20 years

Among these, solar thermal technologies are approaching a level of development that is close to, but not yet quite ready for commercial market acceptance. Over the past decade, since the Congress in the Solar Energy Research, Development and Demonstration Act of 1974 (PL93-473), set forth this policy three major basic technologies have emerged which can effectively generate electricity and heat from sunlight: parabolic trough systems, parabolic dish systems, and central receiver systems. (See Fig. #1)

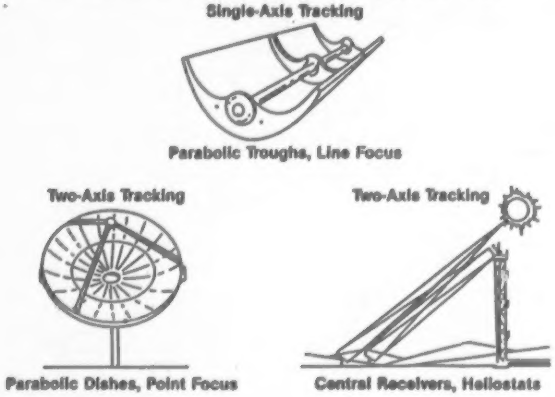

Single-Axis Tracking
Parabolic Troughs, Line Focus
Two-Axis Tracking
Two-Axis Tracking
Parabolic Dishes, Point Focus
Central Receivers, Heliostats

Figure 1. Solar Thermal Energy Conversion Systems

Proof-of-concept for these solar thermal technologies has been accomplished and a national resource has been constructed in the form of major testing facilities and small industrial applications. These facilities provide the means for demonstrating prototype system viability leading to commercial-scale demonstrations and market entry. The remaining steps to this commercialization process for dishes and central receivers are subsystem scale operation and pre-commercial system demonstrations to validate performance and economics (As shown in Figure 2) A significant market will emerge in the 1990s as energy demand continues to increase and conventional energy prices rise.

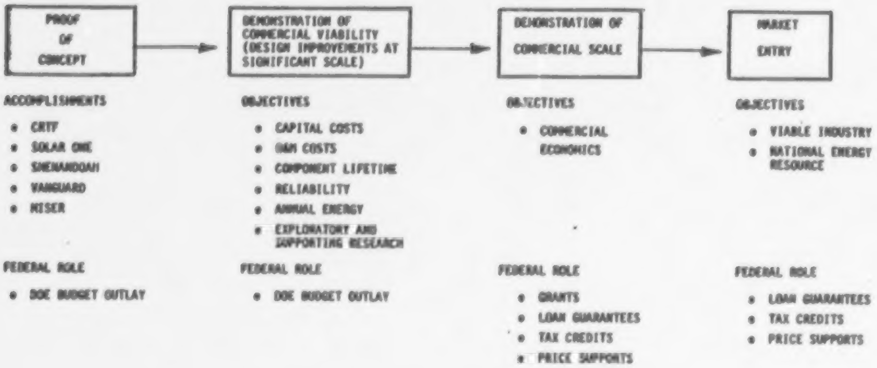


FIGURE 2 - PATH TO COMMERCIALIZATION OF SOLAR THERMAL TECHNOLOGY

Each of these technologies has applications for which it is especially well suited, depending on storage and temperature capability (see Figure 3).

Type of Application	Most Economic Demand Application		
	Peak Demand (Sun-Following)	Level of Extended Demand	
		Small/Storage	Large/Storage
Electricity	Dishes	Troughs	Central Receivers
Low-Temperature Heat (100-300°C)	Troughs	Troughs	Central Receivers
High-Temperature Heat (>300°C)	Dishes	Central Receivers Dishes	Central Receivers
Innovative Applications	Dishes Troughs	Central Receivers	Central Receivers

Figure 3. Technology/Applications Matrix

The solar central receiver technology for example is ready to transition from the proof-of-concept stage at the 10MWe Solar One experiment near Barstow, California. Central receivers are an example of a promising new energy source that is in need of federally financed scale-up experiments and demonstration projects to bridge the gap to successful entry into the commercial market place.

The critical factor in the marketing process is convincing the user of reliable operation, annual electricity production (KWh/yr) an reasonable O&M costs. One or more precommercial plants or system scale-up experiments are required to demonstrate these parameters. The capital cost and associated risks of production and operating costs of such demonstrations or experiments is too large at this time for private industry to undertake without government financial support.

To illustrate this point, attempts to secure private financing for several large scale solar central receiver system demonstrations have been unsuccessful thus far because of the considerable technical and economic risks in scaling up from 5 MW_t at CRTF and 10MWe at Solar I to sub-commercial and commercial scale plants of 30MWe, 60MWe and 100 MWe size.

The major reason that government financing is required lies in the fact that a solar thermal plant for electricity production is a system, composed of many subsystems: solar collectors, solar receiver/boilers, thermal storage, heat exchangers, turbine generators and interconnecting circuitry and control facilities. Consequently,

1) There is no one industrial user or manufacturer that can take the risk of complete solar thermal systems development because no one industrial group will ever manufacture, test and market complete utility systems and hence profit from the entire system.
2) For a group of industries to spread the development risk among themselves, they must be assured of a predictable market for their subsystems to be integrated into complete solar thermal electric systems.
3) To generate the market required for individual company risk investment, the system users (e.g. utilities or third party investors) must be convinced of system reliability and the O&M costs.
4) When the market exists, manufacturers will work to get costs down to the point required for competitive electricity production.

On-the-board projects and plans exist for these large scale experiments and demonstrations. They are: Solar 100 (SCE & MDAC), Saguaro (APS & Black & Veatch), Carissa Plains (PG&E & Rockwell). At present, all of these plans and projects are essentailly on hold as far as construction go ahead is concerned because of the lack of financing. Thus, the process of going from a successful technolgoy development stage to the necessary precommercialization activities is dependent on some type of federally financed program.

The industry strongly recommends the establishment of a much needed government role, one that will provide financial support for these pre-commercial system demonstration initiatives and maintain the industry momentun to achieve our common goal of commercial market acceptance.

In addition to energy tax credits, action by the Congress to provide federal government support in the form of grants, loan guarantees and/or price supports for early first-of-a-kind hardware demonstrations is urgently requested.

Clearly, the renewable energy industry has made significant progress since the U.S. first turned its attention to these resources in the early 1970s. With a decade of growth and experience, and continuing federal government support, these technologies will be impacting every sector of our economy; residential, commercial, industrial and transportation, and providing the U.S. with a world leadership role in developing alternative energy resources.

The road ahead is an uphill one. For these technologies to realize their potential, they must be able to compete with conventional energy sources which have the benefit of long-estabilshed tax and institutional preferences. Only in the presence of a stable and supportive public policy environment and continued research and development will commercialization of renewable energy technolgoies occur smoothly and expeditiously.

ACUREX
Corporation

June 18, 1984

Honorable Don Fuqua, Chairman
Subcommittee on Energy Development
and Applications
U.S. House of Representatives
Washington, DC 20515

Dear Mr. Fuqua:

On behalf of the Acurex Corporation, and its subsidiary, the Acurex Solar Corporation, I would like to provide our views on the subject of cost-shared energy projects as this issue relates to our experiences in marketing parabolic trough and parabolic dish solar thermal systems.

Four years ago Acurex made a commitment to market parabolic trough systems commercially because we believed that the technology had been sufficiently developed to permit the sale of economicially attractive and technologically reliable systems. The parabolic trough was the most advanced of the solar themal options and had had the benefit of a rather extensive Department of Energy (DOE) demonstration program.

Unfortunately, in attempting to market and sell these systems we discovered that the existence of "proof-of-concept" demonstration systems was a necessary but not sufficient condition for ensuring commercial sales. In that sense our experiences agreed with the issues raised by Dr. Straughan at your subcommittee hearing on the subject on June 13.

What we found was that the existence of a DOE demonstration program had removed much of the technical uncertainty surrounding the operation of parabolic trough systems. However, because these demonstration systems employed developmental hardware, were sub-optimal in size, and often were sited at poorly chosen locations, they did little to demonstrate the economic feasibility or benefits of the technology. Coupled with high interest rates and flat or declining competing energy prices, the absence of economic feasibility demonstrations left potential purchasers with little incentive for investment in trough systems when that investment was compared with alternatives with equal or greater assured returns and little or no technical risk.

As was noted at the hearing, the government had handed the technology off to industry at the end of the second phase of RD&D process, technical proof-of-concept. The industry was to have taken the technology through the next phase, economic proof-of-concept, and onto commercial exploitation by itself. Unfortunately,

1655 North Fort Myer Drive, Suite 700, Rosslyn, VA 22209 (703) 276-9066
Corporate Headquarters
555 Clyde Avenue, P.O. Box 7555, Mountain View, CA 94039 (415) 964-3200 Telex: 34-6391 TWX: 910-3796593

the capital-intensive nature of the technology makes it difficult for small to medium size companies, like ours, to accomplish the necessary third phase development by constructing systems as "loss-leaders" as was suggested by one of the witnesses at the hearing. On the other hand, large companies with greater access to capital often have a myriad of competing requests for use of those resources, making it difficult to justify investment in loss leaders with little or no guaranteed follow-on markets.

As a result, since the end of the DOE trough demonstrations there has been only one large-scale commerical sale of a parabolic trough system in which the financing of the system was obtained in the open financinal marketplace. One other very large trough system currently under construction in southern California employs foreign-made hardware and a financing package made possible by foreign subsidization. Over the past several years numerous "sales" were made and lost due to an inability to raise investment capital either for direct sales or third party investments.

The experiences of the trough industry are good examples of cases in which some form of government risk-sharing could have been used to stimulate development of an industry. Unfortunately, after the virtual end of the trough program in FY81, the only mechanism available for stimulating sales has been the Business Energy Investment Tax Credit. Because this credit was instituted at a sub-optimal level, the benefits of which were futher eroded by TEFRA, falling fossil fuel prices, and repeated threats of repeal, it has done little to stimulate sales. In the absence of of a tax credit at levels (25% or more) which could actually encourage capital investment, it is necessary for the government to consider some form of on-budget mechanism, if it is the desire of the government to assist these technologies in entering the marketplace. Possibly, one approach might be to consider some form of reimbursable risk-sharing similar to that proposed by the Sacramento Municipal Utility District for financing of its photovoltaic power plant, conceivably using a revolving fund such as was proposed by Dr. Savitz at the hearing.

It is my belief that a properly structured government risk-sharing program for parabolic troughs could lead to significant commerical sales in the very near future, with little actual federal investment. The technology is close enough to being fully commercial for the required federal stimulus to be a rather small percentage of total project cost.

In contrast, the other solar thermal technology in which Acurex has an interest, the parabolic dish, is much further from the marketplace and requires a far more extensive federal support plan if it is ever to achieve the status of a commercial technology.

Parabolic dishes have yet to have their first proof-of-concept technical demonstration, which will come about with the construction of the two DOE-funded Small Community projects, later this year. These projects will provide the development program with working systems which can be used to resolve some of the technical issues which always arise in technology development programs. However, these two systems will be nowhere near commercial from an economic standpoint and will not provide sufficient credibility on which to base commercial sales.

If the DOE and the Congress wish for parabolic dish systems to have the opportunity to succeed commercially, it will be necessary to develop a plan of technical development and economic feasibility demonstration. It is disconcerting that DOE plans to date for parabolic dish development do not include any additional system demonstration experiments beyond the Small Community projects. Without such later demonstrations, employing advanced hardware, commerical sales are virtually doomed, unless competing energy prices escalate suddenly. I hope that the subcommittee will consider using the parabolic dish development program as a test-bed for development of a realistic DOE technology transfer program. The relatively low cost and modular nature of the parabolic dish system make it ideal for this purpose; a balanced program can be developed within the constraints of the DOE program budget.

In closing, I appreciate the Subcommittee's continued interest in the RD&D and commercialization process and I look forward to working with you to develop a DOE program which sucessfully completes the technology transfer process for the solar thermal technologies which we have so successfully developed to this point.

Sincerely,

Joel A Weiss

Joel A. Weiss, Ph.D.
Manager
Washington Operations

JAW/bb

MP-84-04

STATEMENT OF

ROGER G. LITTLE
PRESIDENT
SPIRE CORPORATION
Bedford, Massachusetts 01730

Regarding:
Hearings on Cost-Shared Energy
Technology Facilities and Projects

June 13, 1984

Submitted to the:

COMMITTEE ON SCIENCE AND TECHNOLOGY
SUB-COMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS
U. S. HOUSE OF REPRESENTATIVES

INTRODUCTION:

Problems have been experienced by industry in commercializing solar photovoltaic technology developed by the federal research and development program. There is need for cost-shared large-scale advanced manufacturing facilities to bridge the gap between the federal research and development programs and commercialization.

BACKGROUND:

Serious problems have been experienced by industry in commercializing solar photovoltaic energy technology. These problems are due to the high cost of crystalline silicon photovoltaic modules which are a result of small scale, inefficient, non-automated manufacturing approaches. Federal research and development programs have resulted in lower cost cyrstalline silicon sheet material, high efficiency cell processing sequences and fully automated manufacturing procedures. Should this technology be employed in large scale manufacture, dramatic improvements in PV module cost and performance could be achieved.

Although research on advanced low-cost thin film approaches is being pursued by industry and under federal support, a number of years are required for these technologies to become technically and commercially viable, field tested, and achieve significant production volumes. While U.S. industry is tying its future to thin films, especially amorphous silicon, the Japanese industry is rapidly scaling up its crystalline silicon production lines using advanced manufacturing techniques, much of which were developed under the Department of Energy Technology Development Program. The Japanese have targeted the U.S. as a major market for their product. Kyocera is now doing site surveys in the U.S. for the location of a crystalline silicon production line. Hoxan has announced the start of a 10 megawatt per year production line using advanced ion implantation technology, an approach pioneered by Department of Energy supported research.

It is necessary to improve and increase crystalline silicon manufacturing capacity to insure a place for the U.S. PV industry in the growing domestic and international market of the next 5 years. Only if the U.S. industry is helped now will it be able to satisfy utility PV requirements of the future. These requirements are projected by the Office of Technology Assessment to be as great as 600 megawatts in 1990, and 2000 megawatts in 1995. It is recommended that federal help be provided to produce large scale, crystalline silicon PV module production lines using a range of silicon sheet material, advanced high efficiency processing technology, and automated machine concepts that have been developed by the federal research and development program.

ADVANCED PHOTOVOLTAIC PRODUCTION LINES:

The generic characteristics of a number of advanced photovoltaic production lines have been identified by a DOE study and can be summarized as follows:

PHOTOVOLTAIC PRODUCTION LINES*

Technology:	Advanced high efficiency crystalline silicon
Sheet Material:	Advanced Cz, Web, EFG, HEM, RTR, etc.
Production Level:	30 megawatts per year
Processing:	Semi-automated
Estimated Capital Cost:	$44M (current $)
Time to full scale production:	2 Years
Cost of Module Manufacture:	$3.50 per watt (current $)

The assembly and operation of such production lines would provide relatively low-cost modules for utility applications, thereby increasing market development and demonstration, which would accelerate commercialization and industry growth. These modules can also be employed immediately in utility demonstration programs. Industry is unlikely to fund such lines themselves.

Such an investment does however, represent substantial risk because of the possibility for PV technology "breakthroughs," although such occurences are remote due to the depth of research and development that has been performed in photovoltaics, this potential for manufacturing line obsolescence has prevented industry from investing in large-scale advanced crystalline silicon production lines.

It is, therefore, recommended that the Federal government cost-share large-scale crystalline silicon manufacturing lines using the advanced technology developed under federally-supported research and development programs.

---

* from "Comparison of $2.80/$W_p$ Technical Readiness Projection for 1982 with Present Industrial Practices," Dr. P. Henry, DOE/FSA Project Integration Meeting Jan. 1983.

MECHANISM FOR PROVIDING ASSISTANCE:

The mechanism for providing assistance while minimizing federal expenditures and intrusion into the marketplace can be as follows:

(1) Issue a solicitation to industry for 2 or 3 such production lines using demonstrated high efficiency crystalline silicon technology. The solicitation could also allow other demonstrated, field tested technologies.

(2) Require industry cost-sharing as part of the award criteria.

This approach has, in fact, been utilized, on a smaller scale in the Jet Propulsion Laboratory Technology Development Program for its MEPSDU* procurements.

In 1980 a solicitation was issued to industry for two 5 MW/yr pilot production lines. In 1981 awards were made to Westinghouse and Solarex totalling about $6 M. Each of these awards involved approximately 30 percent cost-sharing. Although on a success path, the programs were cut back in 1982 and were abandoned in 1983. This experience provides the precise mechanisms for the proposed cost-share program.

SUMMARY:

U.S. industry has chosen not to scale up advanced crystalline silicon photovoltaic manufacturing technology but to pursue thin film approaches. Even if successful, it is unlikely that thin film technology will be able to meet the market demands of the near-term including utility requirements of 1990. On the other hand, the Japanese are moving rapidly into crystalline silicon technology. Cost-sharing by the Federal government to assemble large-scale advanced, high efficiency crystalline silicon production lines using federally-supported R&D would stimulate market growth and commercialization and ensure the U.S. industry a place in the markets of the future.

---

* MEPSDU - Module Experimental Process System Development Unit

PROJECT ANALYSIS AND INTEGRATION

ECONOMIC PROJECTIONS AND FSA RESEARCH PRIORITIES

JET PROPULSION LABORATORY

P.K. Henry

1. **Comparison of economic projections made in 1980 with present practices**
2. **a. "Where are we now in ribbon-based technology development?"**
   - **b. Recent economic projections for ribbon-based technology**

Comparison of \$2.80 / W_p Technical Readiness Projection for 1982 With Present Industrial Practices

	Projection made in 1980 for 1982,* 1980\$/W_p	Present,* 1980\$/W_p	
	30 MW/yr	30 MW/yr	2 MW/yr
Ingot growth (incl. silicon)	1.63	1.53	1.74
Sawing	0.37	0.42	0.77
Cell processing	0.36	0.31	0.84
Module assembly (incl. Encap. Mat'l)	0.34	0.37	0.92
FOB factory dock required price	2.70	2.63	4.27
Marketing and distribution (30%-50%)	0.81-1.35	0.79-1.31	1.28-2.13
Inflation (1980-1982) (14.5% est) (25.4% actual)	0.89-1.03	0.87-1.00	1.41-1.63
Required market price,** 1982\$/W_p	4.40-5.08	4.29-4.94	6.97-8.03

*Assumes 11.4% encapsulated-cell efficiency and 0.78 packing factor

**To convert to \$/m^2 of module, multiply by 89.4

PROJECT ANALYSIS AND INTEGRATION

Factors That Differed From Projections Made in 1980

FACTORS RAISING REQUIRED PRICE

- **Interest on corporate debt**
  - **Projected: 9.25%**
  - **Actual: ~16%**
- **Slices/cm of ingot sawing**
  - **Project: 20 slices/cm**
  - **Actual: 17 slices/cm**
- **Saw blade life**
  - **Projected: 3100 slices**
  - **Actual: 2500 slices**

FACTORS LOWERING REQUIRED PRICE

- **Silicon cost (1980$)**
  - **Projected: $84/kg**
  - **Actual: $55/kg**
- **Silver cost (1980$)**
  - **Projected: $18.40/oz**
  - **Actual: $9.00/oz**
- **Cell-processing cumulative yield**
  - **Projected: 89.1%**
  - **Actual: 90.0%**

Comparison of $2.80 / W_p Technical Readiness Projection for 1982 With Present Industrial Practices: Summary

- **All processes, equipment, and module design factors assumed in the projections made in 1980 have been adopted by industry (not all co-located)**
- **With exception of sawing, all technical and performance parameters have equalled or exceeded the projections made in 1980**
- **Factors outside the control of the PV Program have had mixed effect on manufacturing costs (market volume, commodity prices, interest rates)**

Comparison of State-of-the-Art Ribbon Technology (Scaled Up) With Projections of Ribbon Technology

Ground rule for state-of-the-art ribbon technology scaled up to commercial production in 1985

- **All equipment and processes must be presently in use in the industry or proven to the point that equipment can be ordered for installation and operation by 1985**

Assumptions

	Scaled-up state of the art	Intermediate projection (Late 1980s)	Long-term projection (Early 1990s)
Factory size, MW/yr	25	25	25
Year of production	1985	1988	1990
Ribbon type	Dendritic web	Dendritic web	Dendritic web
Silicon cost, 1980$/kg	55	14	14
Web growth rate, cm^2/min	10	25	35
Growth machines/operator	6	18	18
Encapsulated-cell efficiency, %	12.3	13.5	15
Packing factor	0.92	0.92	0.92
Module efficiency, %	11.3	12.4	13.8
Cumulative cell process yield	0.77	0.93	0.93

PROJECT ANALYSIS AND INTEGRATION

(1980 \$) / W_p

	Scaled-up state of the art*	Intermediate projection (Late 1980s)	Long-term projection (Early 1990s)
Sheet growth (incl. silicon)	1.61	0.21	0.14
Cell processing	0.27	0.22	0.19
Module assembly (incl. encap. matl)	0.18	0.16	0.15
FOB factory dock required module price			
(1980\$/W_p)	2.06	0.59	0.48
(1980\$/m^2)	233	73.3	66.2

*Technology in existence today but not yet used in full scale commercial production

Summary

- Ribbon growth rates still low due to lack of understanding of thermally induced stresses; high growth rates significantly reduce module price
- Further research and development into process control and equipment parameters would result in higher yeilds and efficiencies sufficient to produce modules at \$0.70/W_p or less
- Once \$0.70/W_p technology is achieved, modest improvements in ribbon growth rate and cell efficiency can bring \$0.50/W_p or less within reach

PROJECT ANALYSIS AND INTEGRATION AREA

Technology Session **Paul K. Henry, Chairman**

A discussion of Technical Readiness of \$2.80/W_p technology was presented in the plenary session. The discussion examined the way in which the most widely used technology in the industry, Czsochralski ingot, could meet the 1982 \$2.80/W_p commercial production milestone in the National Photovoltaics Program.

The analysis of energy payback time for photovoltaic module manufacturing responds to an increasing number of requests to the LSA Project for estimates of energy payback time and inquiries regarding conflicting estimates from other sources. The discussion described how energy payback time computation is incorporated in SAMIS and how the energy content of materials is being assembled into a data base in the Cost Account Catalog.

The latest addition to the SAMICS family of models, IPEG4, was introduced by Robert Chamberlain and Paul Firnett. IPEG is a major expansion in the capabilities, flexibility and simplicity of applying SAMICS, and it is cheap. A single SAMIS run is used to generate input data for IPEG4. Sensitivities can than be run quickly for any of the process input parameters.

TECHNICAL READINESS \$2.80 W_p

JET PROPULSION LABORATORY
Paul K. Henry

Agenda

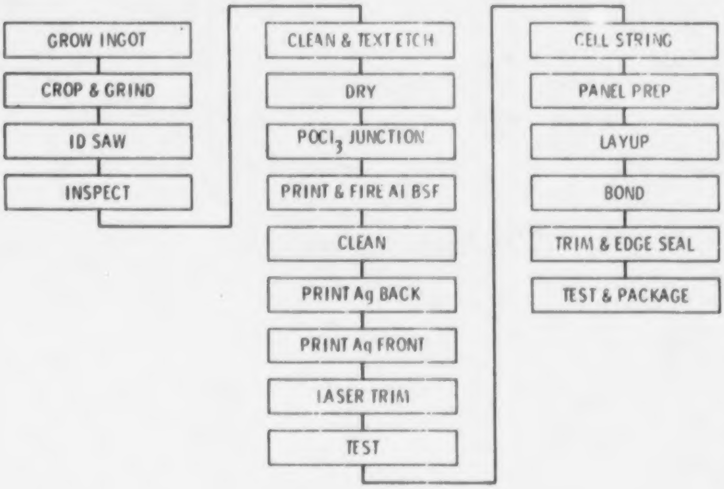
1. BACKGROUND
2. 1980 PRODUCTION TECHNOLOGY WHERE ARE WE NOW?
3. 1982 PRODUCTION TECHNOLOGY WHAT DOES IT TAKE TO GET TO \$2.80/W_p?
   - a) 1982 BASELINE CASE A CONSERVATIVE ESTIMATE
   - b) SENSITIVITY TO VARIOUS PARAMETERS

PROJECT ANALYSIS AND INTEGRATION AREA

Financial Parameters That Apply for All Cases

AFTER-TAX RATE OF RETURN (EQUITY CAPITAL	20%/YR
INTEREST RATE ON CORPORATE DEBT	9 1/4%/YR
COMBINED STATE/FEDERAL CORPORATE INCOME TAX RATE	50%
MAXIMUM INVESTMENT TAX CREDIT	11%
PROPERTY TAX RATE	2%/YR
INSURANCE PREMIUM RATE	4%/YR
GENERAL INFLATION RATE (AFTER 1980)	7%/YR
CONSTRUCTION AND EQUIPMENT CONTINGENCIES	15%
AVERAGE TIME IN INVENTORY FOR RAW MAT'LS & FINISHED GOODS	2 WEEKS
DAYS COMPANY CLOSED	20 DAYS
DAYS PER WORKER'S WEEK	5 DAYS
PAID DAYS OFF (HOLIDAYS, VACATION, SICK LEAVE, JURY DUTY, ETC.)	39 DAYS

Process Sequence Applied to Both 1980 and 1982 Cases



PROJECT ANALYSIS AND INTEGRATION AREA

1980 Commercial Production Case Ground Rules

- ALL EQUIPMENT AND PROCESSES MUST PRESENTLY BE IN USE IN FULL-SCALE PRODUCTION SOMEWHERE IN THE INDUSTRY

- ALL EQUIPMENT AND PROCESSES NEED NOT PRESENTLY BE COLOCATED

1980 Commercial Technology Assumptions

GENERAL

- PRODUCTION YEAR 1980
- FACTORY SIZE 5 MW/yr
- 3 SHIFTS DAY, 7 DAYS/WEEK FOR INGOT GROWTH & SLICING
- 1 SHIFT DAY 5 DAYS WEEK FOR ALL OTHER WORK STATIONS

SILICON MATERIAL

- POLYSILICON COST - $84 Kg

PROJECT ANALYSIS AND INTEGRATION AREA

MODULE DESIGN AND PERFORMANCE:

- CELL DIAMETER - 4.015 INCH (102 mm)
- 2.5 FT x 4 FT MODULE (0.76m x 1.22m)
- GLASS SUPERSTRATE, PVB, CRANE GLASS, TEDLAR
- EXTRUDED ALUMINUM FRAME
- PACKING FACTOR - 77%
- MODULE EFFICIENCY - 9.47%
- ENCAPSULATED CELL EFFICIENCY - 12.3%
- MODULE PERFORMANCE - 88 W_p/MODULE
- SERIES-PARALLELING - 11 CELLS/STRING, 8 PARALLEL STRINGS
- BYPASS DIODE

INGOT GROWTH:

- ONE 20 kg Cz INGOT PER CRUCIBLE

INGOT SAWING:

- ID SAWING - 25 mils/SLICE PLUS KERF
- SAWING RATE - 1.5 in/min
- SAWING YIELD - 95%
- SAWS/OPERATOR - 3
- BLADE LIFE - 2500 SLICES

CELL PROCESSING:

- TEXTURE ETCHED
- $POCl_3$ JUNCTION FORMATION
- ALUMINUM BSF
- CLEAN & BRUSH
- PRINTED SILVER FRONT AND BACK CONTACTS ($18.40/oz SILVER)
- CELL PROCESSING YIELD - 87%

MODULE ASSEMBLY:

- CELL STRINGER - $75K EACH
- CELL STRINGERS/OPERATOR - 1
- MODULE TEST YIELD - 90%

1980 Commercial Technology Value Added (1980$)

	VALUE ADDED ($/$W_p$)
INGOT GROWTH (INCL. SILICON)	2.86
SAWING	0.83
CELL PROCESSING	0.65
MODULE ASSEMBLY (INCL. ENCAPSULATION MAT'L)	1.20
	$5.54/$W_p$

PROJECT ANALYSIS AND INTEGRATION AREA

1982 Commercial Technology Ground Rules

- 1982 BASELINE CASE:

  ALL EQUIPMENT AND PROCESSES MUST BE PRESENTLY IN USE OR PROVEN AND AVAILABLE FOR PURCHASE, INSTALLATION AND COMMERCIAL OPERATION BY LATE 1982. ALL PARAMETERS VERY WELL KNOWN.

- SENSITIVITY CASES:

  SUBSTITUTE OPTIMISTIC OR PESSIMISTIC VALUES FOR CERTAIN KEY PARAMETERS

1982 Commercial Technology Assumptions

GENERAL:

- * FULL-SCALE PRODUCTION STARTS LATE 1982
- * FACTORY SIZE - 30 MW/yr
- * 3 SHIFTS/DAY, 7 DAYS/WEEK FOR ALL WORK STATIONS

*INDICATES A DEPARTURE FROM 1980 COMMERCIAL TECHNOLOGY CASE

PROJECT ANALYSIS AND INTEGRATION AREA

MODULE DESIGN AND PERFORMANCE:

- CELL DIAMETER - 4.015 INCH (102mm)
- *4ft x 4ft MODULE (1.22m x 1.22m)
- GLASS SUPERSTRATE, *EVA, CRANE GLASS, TEDLAR
- *NO FRAME
- *PACKING FACTOR - 78% (ROUND CELLS)
- *MODULE EFFICIENCY - 9.6%
- ENCAPSULATED CELL EFFICIENCY - 12.3%
- *MODULE PERFORMANCE - 143 W_p/MODULE
- *SERIES-PARALLELING - 11 CELLS/STRING, 13 PARALLEL STRINGS
- BYPASS DIODE

*INDICATES A DEPARTURE FROM 1980 COMMERCIAL TECHNOLOGY CASE

SILICON MATERIAL:

- POLYSILICON COST - $84/Kg ($1980)

INGOT GROWTH:

- *TWO 26 Kg Cz INGOTS PER CRUCIBLE

INGOT SAWING:

- *ID SAWING - 20 mil/SLICE PLUS KERF
- *SAWING RATE - 2.0 in/min
- SAWING YIELD - 95%
- *SAWS/OPERATOR - 5
- *BLADE LIFE - 3100 SLICES

*INDICATES A DEPARTURE FROM 1980 COMMERCIAL TECHNOLOGY CASE

PROJECT ANALYSIS AND INTEGRATION AREA

CELL PROCESSING:

- TEXTURE ETCHED
- $POCl_3$ JUNCTION FORMATION
- ALUMINUM BSF
- CLEAN AND BRUSH
- PRINTED SILVER FRONT AND BACK CONTACTS ($18.40/oz SILVER)
- * CELL PROCESSING YIELD - 89.1%

MODULE ASSEMBLY:

- * CELL STRINGER - $200K EACH
- * CELL STRINGERS/OPERATOR - 4
- * MODULE TEST YIELD - 99%

*INDICATES A DEPARTURE FROM 1980 COMMERCIAL TECHNOLOGY CASE

1982 Commercial Technology Value Added (1980$)

	VALUE ADDED ($/$W_p$)
INGOT GROWTH (INCL. SILICON)	1.63
SAWING	0.37
CELL PROCESSING	0.36
MODULE ASSEMBLY (INCL. ENCAPSULATION MAT'L)	0.34
	$2.70/$W_p$

PROJECT ANALYSIS AND INTEGRATION AREA

$\$/W_p$ Effect of Changes Between 1980 and 1982 Technologies

PROCESS STEP	PARAMETERS	1980	1982	$\Delta\$/W_p$
INGOT GROWTH	INGOTS/CRUCIBLE	1	2	$0.40
SAWING	SLICE + KERF (D+K)	25	20	0.39
	SAWS/OPERATOR	3	5	0.18
	BLADE LIFE (SLICES)	2500	3100	0.02
ALUMINUM BACK	YIELD	98%	99%	0.04
	PRINTERS/OPERATOR	2	3	0.02
SILVER FRONT/BACK	YIELD (EACH)	98%	99%	0.08
	PRINTERS/OPERATOR	2	3	0.04
LAMINATION	THROUGHPUT RATE (MODULES/MIN)	0.2	0.3	0.03
EDGE TRIM & SEAL	FRAME	FRAME	NO FRAME	0.48
MODULE TEST	YIELD	90%	99%	0.50
				$2.18
	SHIFTS/DAY	3-INGOT & SAW 1 REST OF PLANT	3 (7 DAYS/WK)	0.54
	MISC			0.12
	BOTTOM LINE ($\$/W_p$)	$5.54 –	$2.70 =	$2.84

Total Initial Capital Investment

PLANT DESCRIPTION	TOTAL INVESTMENT (MILLIONS)	DIVIDED BY OUTPUT ($/W)
1980 5 MW	12.6	2.5
1982 5 MW (4 SHIFTS)	7.8	1.6
1982 15 MW (4 SHIFTS)	17.6	1.2
1982 30 MW (4 SHIFTS)	32.7	1.1

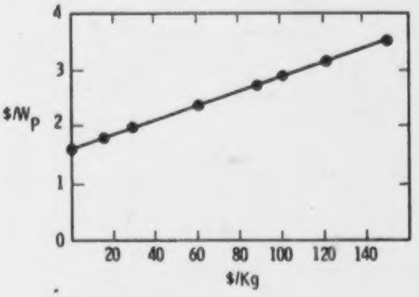
*IN 1980 DOLLARS. INCLUDES EQUIPMENT, WORKING CAPITAL, ALL FACILITIES AND LAND.

PROJECT ANALYSIS AND INTEGRATION AREA

Silicon Price Sensitivity

BASED ON THE $2.70/W CASE WITH THE 2 INGOTS/CRUCIBLE
Cz FURNACE AND 20 mil D+K ID SAWS:

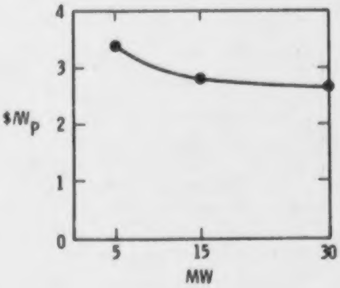
SI PRICE ($/kg)	MODULE PRICE ($/W)
0	1.55
14	1.74
28	1.93
60	2.37
84	2.70
100	2.92
120	3.19
150	3.60



Factory Size Sensitivity

BASED ON THE $2.70/W CASE WITH THE 2 INGOT/CRUCIBLE
Cz FURNACE, 20 mil D+K SAWS:

FACTORY SIZE (MW)	MODULE PRICE ($/W$_p$)
5	3.35
15	2.82
30	2.70

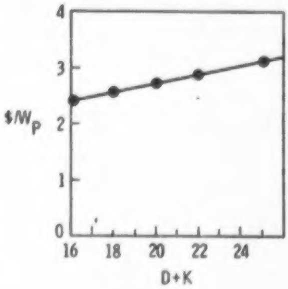


PROJECT ANALYSIS AND INTEGRATION AREA

Saw Slice + Kerf (D + K) Sensitivity

BASED ON THE \$2.70/W_p CASE WITH THE 2 INGOT/CRUCIBLE Cz FURNACE, 2 INCH/MINUTE PLUNGE RATE:

D+K (MILS)	MODULE PRICE \$/W_p
25	3.09
22	2.86
20	2.70
18	2.54
16	2.39



Major Components of Capital Investment*

COMPONENT	1980 (5 MW)	1982 (5 MW)	1982 (15 MW)	1982 (30 MW)
WORKING CAPITAL	2.8	1.8	4.8	9.3
FACILITIES	2.7	1.8	3.1	5.3
SAWS	1.6	1.1	3.2	6.4
Cz EQUIPMENT	1.2**	1.0	3.0	6.0
PRINTERS + DRYERS	0.6**	0.2	0.4	0.6
OTHER CELL EQUIPMENT	2.4**	1.1	1.8	2.9
REMAINING EQUIPMENT	1.2**	0.7	1.2	2.1
TOTAL EQUIPMENT	7.0	4.1	9.6	18.0

*IN MILLIONS OF 1980 DOLLARS.

**OPERATED 40 HOURS/WEEK. OTHER EQUIPMENT OPERATED 160 HOURS/WEEK.

PROJECT ANALYSIS AND INTEGRATION AREA

Options for Further Price Reductions

- NONPRECIOUS METALS
- PLATING METALLIZATION
- SEMIX INGOT GROWTH
- HEM INGOT GROWTH
- WEB RIBBON
- EFG RIBBON
- IMPROVED SAWING

Summary

- PATH FROM 1980 COMMERCIAL TECHNOLOGY TO 1982 COMMERCIAL TECHNOLOGY CLEARLY DISCERNIBLE - AUTOMATION, YIELDS, MODULE DESIGN
- ALL ASSUMPTIONS QUITE CONSERVATIVE - NO OPTIMISTIC ASSUMPTIONS NECESSARY
- MODULE ENGINEERING - IMPORTANT FACTOR
- BY 1982, CELL AND MODULE PROCESSING WITHIN FACTOR OF 2 OF 1986 GOAL
- INGOT GROWTH AND SAWING WILL BE LARGE 1982 COST DRIVERS
- POLYSILICON WILL CONTRIBUTE OVER $1.00/W TO 1982 PRICE

Conclusions

- TECHNICAL READINESS FOR $2.80/W$_p$ COMMERCIAL PRODUCTION IN 1982 HAS BEEN ACHIEVED
- SEVERAL OPTIONS EXIST WHICH COULD DRIVE THE PRICE WELL BELOW $2.80/W$_p$ BY LATE 1982 OR 1983